ELECTRICAL WORLD
AND
Electrical Engineer.

ELECTRICAL WORLD, Vol. 33, No. 19. NEW YORK, MAY 13, 1899. ELECTRICAL ENGINEER, Vol. 27, No. 575.

PUBLISHED EVERY SATURDAY BY

ELECTRICAL WORLD AND ENGINEER

(Incorporated).

120 LIBERTY STREET, NEW YORK.

Telephone Call: 4044 Cortlandt. Cable Address: Electrical, New York.

Chicago Office, - - - - - - - - 936 Monadnock Block.
Philadelphia Office, - - - - - - 929 Chestnut Street.

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(Entered as second-class mail matter at the New York Post Office.)

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NEW YORK, SATURDAY, MAY 13, 1899.

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The Volta Centennial.

It is somewhat a happy coincidence that both in America and in Italy two electrical exhibitions should be going on at the same time, both in reality celebrating the close of the first century during which the electrical arts have had a practical supply of current. It is true that the primary battery which we owe to Volta no longer cuts its old figure of importance, but its congener, the storage battery, opens up the second century, in its place, with a career of prodigious usefulness before it. Volta is one of the great Italians who have benefited the world by their discoveries in science and industry, and it is fitting that his work should be celebrated. The efforts of the New York Electrical Society this week to signalize the occasion in this country, by a memorial meeting, are most laudable, and it is to be hoped that the occasion at Madison Square Garden on Saturday night will mark very emphatically the sense of American electricians as to the honor due to the memory of their great forerunner and benefactor, Volta.

The enormous significance of Volta's discovery is apparent when we reflect on the state of electricity previously, and on the great consequences which during the next third of a century flowed from it. Until then the only source of electricity was the static machine which, with its infinitesimal capacity for the transformation of energy, remains to-day, in this electrical age, an entirely negligible factor. The voltaic cell first made man acquainted with electricity as a recognizable form of energy. Possessed of this potent source, experiments in every direction immediately followed, the science of electro-chemistry at once sprang into being, and finally by its means the great discovery of Faraday was made. Though we now see in the great electrical development of to-day only reminders of Faraday, sight should not be lost of the fact that the discovery of electromagnetic induction sprang from the discovery of Volta now being celebrated at Como.

The Electrical Exhibition.

When the out-of-town members of the National Electric Light Association arrive in New York City for the annual convention they will find a beautiful and interesting exhibition awaiting them in Madison Square Garden. It was a wise decision not to make the opening of the convention simultaneous with the opening of the show, as was done in 1896, the two events coming together being rather more than any one could conveniently attend to in the way they deserved. This year the show will be in smooth running order long before the work of the convention has to be done, and many of its features will deserve the best consideration the members can give them. The fine automobile exhibit, for example, will set them thinking as to this great new outlet for current, while the historical arc lamp collection will carry their minds back over the hard field of struggle traversed during the past twenty years in that entirely different yet allied branch of the art. The use of a beam from a searchlight to convey speech will also have its suggestiveness. In fact, the features of interest are many, yet the management has been careful to avoid the hackneyed and commonplace. We venture to

predict that the exhibition will win all the success that has been striven for so strenuously and bravely.

The Electric Railway Return Circuit.

In another column we print a letter criticising some remarks recently appearing in this column, and bearing on the subject of the electric railway return circuit. The agitation of the question of electrolysis from railway currents has almost invariably been started and maintained by those having little or no real knowledge of the subject. The expert, as usual, has been much in evidence with his reports colored to suit the supposed interests of his employer—usually a municipality, or a gas or water company; and his ex-parte and often ignorant conclusions have in some instances been seized upon to further the claims of rail bonds warranted as specifics against the great evil alleged to lurk in the railway return. As a consequence, the situation with respect to electrolytic action and the railway ground return has become so befogged, the remedies proposed have been so numerous and the theories offered in support so little related to the real conditions, that the entire subject has come to be looked upon as one embracing a peculiar class of electrical actions, and consequently requiring peculiar remedies.

In the article to which reference is made an endeavor was made to bring out the point that the question of electric railway distribution does not differ from that of any other system of distribution; that, for example, the feeder and main system employed in electric lighting is also an ideal one for electric railway distribution, since the drop may thereby be mostly confined to feeders, thus enabling a fairly uniform potential to be maintained over the railway line. An ideal solution, however, is rarely a commercial one, and in this instance, as pointed out by our correspondent, not only are the evils to be cured largely imaginary, but when they do exist, may be combated by other and much less complicated and expensive means than the employment of an ideal remedy that implies also ideally unfavorable conditions. Electrolytic action from the return railway current is dep ndent upon such numerous factors—such as the character of the soil and strata, the relative situation of underground pipes and the generating point, the length of line, size of rails, character of bonding, the quantity of current and other conditions—that each case, should electrolytic action be suspected, demands a special study. Sometimes the remedy will be very simple, in other cases more complicated, and possibly in an extreme case the ideal solution may be called for.

The Measurement of Insulation Resistance.

The measurement of insulation resistance is necessarily subject to some uncertainty. The insulation resistance of a conductor is a function of the pressure which is employed and of the time during which it has been applied. This must be so from the nature of the case, seeing that the conduction of electricity through insulating substances is quite a different process to its conduction through metals. Standard specifications for the insulation of covered wires commonly call for a given number of megohms per mile at a standard temperature with a specified battery pressure, say 100 volts, and after five minutes electrification. In such cases, the measurement is made by direct deflection using a mirror galvanometer. The results obtained, while they will be usually capable of repetition under the same conditions, within a reasonable degree of closeness, cannot, in general, be duplicated with any other voltage or with any other period of electrification.

In the technical operations of electric light and power distribution, the precise insulation resistance of even underground conductors is a matter of little consequence. If the insulation resistance is over a megohm, the station manager is serenely content, provided that the dielectric resistance is satisfactory under the full working voltage. In fact, the megohm is often looked upon by him as a sort of shadowy ultima thule—to be wished for, but whose absence would be of little practical consequence, provided that break-downs and short-circuits could be safeguarded. To the ordinary portable Wheatstone bridge, a megohm is a sort of vanishing point, to which all parallel lines seem distantly to converge, and the ordinary central station man who measures insulation with a Wheatstone bridge counts upon a megohm much in the same way that some unenlightened peoples count up to ten securely on their fingers and then throw all numbers above ten into the comprehensive term "many." It is undoubtedly true that the ordinary portable Wheatstone bridge cannot realiably measure a megohm. Its usual contents are a total rheostatic resistance of ten thousand ohms, and a maximum bridge ratio of one thousand, making a theoretical range of from one thousandth of an ohm to ten megohms. The sensibility of the galvanometer employed is necessarily a minimum when the very high resistances are used, and the result, when a megohm is reached, is merely a scientifically approached estimate.

Instead of employing a portable Wheatstone bridge to measure insulation resistances, it is far preferable to use the working pressure and a measuring instrument or ammeter of sufficient delicacy directly in the circuit. This is, in fact, the usual process of 100-volt and 200-volt circuits, a voltmeter serving as the measuring ammeter with the advantage that if the insulation should suddenly break down, the instrument cannot be damaged, since the full current can only be such as will indicate the full pressure on the voltmeter scale. In fact, we venture to say that only among the unskilled is the portable Wheatstone bridge ever relied upon for the measurement of high insulations, and that the voltmeter method or its equivalent is the one in most extensive use.

The Operation of Alternators in Parallel.

The tendency of central station practice is undoubtedly towards the development of larger generating units, not only on account of reduced first cost per unit of power, but also on account of economy of operation. Many of these units are alternators, and with large distribution systems it is essential that these alternators should run in synchronism. Consequently, the conditions necessary for the smooth operation of alternators in parallel are yearly deriving more importance and attracting more attention. In the early days of alternating current generators, it was considered wonderful that alternators should be capable of running in parallel at all, and the condition was looked upon as a sort of experimental achievement. Later, when alternators were used for electric lighting systems in this country at frequencies between 120 and 140, it was looked upon as hazardous and unnecessary to run them in synchronism. At the present time, with lower frequencies and extensive power distributions, parallel running is in very extensive use.

In spite, however, of the generality of the operation, much difference of opinion exists concerning the causes which promote or destroy parallel operation. It sometimes happens that alternators cannot be coupled together satisfactorily. The larger the unit, the more disastrous may be the consequences of a failure to synchronize, not merely on account of the temporary failure to generate, but also on account of the more violent stresses that are brought to bear upon the system in the case of large units. The strangest theories have been in vogue from time to time to account for success or non-success in coupling alternators. It has been held that alternators should have very little inductance, and again that they should have very high inductance; that they should have very little armature reaction and also that they should have very great armature reaction; that they should be compound wound, and self-regulating, and also that they

should on no account be compounded; that they should have nearly saturated magnetic fields, and also that they should have fields excited considerably below saturation; that they should deliver sinusoidal electromotive forces, and also that they should deliver non-sinusoidal electromotive forces.

The fact is, however, that the influence of the prime mover is more important than the influence of the details of construction in the alternators themselves. What is wanted in an ideal system of alternator operation is a prime mover which delivers uniform force throughout its revolution or cycle. For this reason, a turbine is preferable to an engine of many cylinders, and a multi-cylinder engine preferable to a single-cylinder engine. Much depends upon the inertia of the generating units and of the steadiness of the force applied and freedom from variation. When engines can be relied upon to deliver their power with a given minimum of variation, the differences in coupling the alternators which they drive will practically disappear. Moreover, it does not at all follow that the engine which regulates its speed, as counted in revolutions per minute, is the best suited for driving alternators for parallel running, or is most free from variation, because an engine may vary its speed quite considerably during each cycle and yet its average speed may be very nearly uniform.

THE MEASUREMENT OF POWER FACTOR.

The present methods of determining the strength of the magnetizing or lagging component of the output of alternating current systems are both crude and inaccurate. As a rule, when any attempt at all is made to determine the so-called "wattless" component of a central station output, it consists in a comparison of the indicated volt-amperes—the quantity obtained by a multiplication of the indicated voltage by the indicated ampere output—with the output in watts. Generally the latter is obtained from a recording wattmeter which only gives the average output during an interval of time, while the volt-amperes are obtained by successive readings of the switchboard indicating instruments. The inaccuracy of this method is forcibly brought to mind by the fact that it often results in a power factor over 100 per cent., a physical impossibility.

It might be argued that it is of comparatively little consequence what the lagging or leading component of the station output is so long as the current drawn from the dynamos, as indicated by the machine ammeters, is below their heating limit, and there is obtained from the recording wattmeters a record of the output in energy to be compared with the coal consumption and the aggregate of the consumers' bills. All, however, who have had to do with alternating current motors of any considerable size realize the exasperating influence they exert upon the regulation, often without clearly appreciating its cause. The main difficulty does not arise from the energy which these motors take, which is as a rule no more than that of direct current machines carrying the same loads, but from the influence of the "wattless" currents reacting upon the various inductances of the circuit. Some means of visibly indicating at the station switchboard or other point the magnitude of these components out of phase with the electromotive forces would give the station engineer a chance to locate them and compensate for them by well known means.

The inherent inaccuracy of determining the lagging output by the comparison of volt-amperes with watts, even where the two quantities are measured by instruments of the same type and comparatively calibrated, may be shown by the following numerical examples: If the volt-amperes exceed the watts by only 1 per cent., it means that there is upon the line a wattless or magnetizing current with a strength fully 14 per cent. of that of the energy current. If the excess is 2 per cent., the magnetizing current is some 20 per cent. as great as the energy current. Thus very great variations of the wattless output, having a disastrous effect upon the regulation, affect but slightly the indicated volt-amperes.

In many systems the custom is growing of using synchronous motors for the large loads and induction motors for the many comparatively small scattered loads, the former being intended in part to introduce a condenser or leading current to balance the lagging component always existing in the induction motor, in order to improve the regulation of the lines and generators. The amount of leading or lagging current which the synchronous motors will introduce into the system of course depends on the excitation of their fields, and the setting of the field rheostats is determined by the crude process of what is called "adjusting for minimum current." When, as is often the case, the current is subject to beats or pulsations of 50 to 75 per cent., and when it is remembered that a variation of 2 per cent. in the minimum means the introduction of a 20 per cent. magnetizing current, it may be readily seen that the process is a very rough one. What is needed is some indicator of the "wattless" or magnetizing component of the current flowing. A laboratory device of this kind is described in an article on another page of this issue entitled, "Phase Angle Measurements," but it is not applicable to commercial work. However, a simple modification of certain standard meters might be made which would enable them to perform this service. The meters referred to are those either indicating, recording or integrating, of the type in which a potential coil is used. By simply connecting this coil in such a way that it will be energized by an e. m. f. 90 deg. out of phase with that impressed upon the circuit connected through the series or current coils of the meter, the instrument will be absolutely unaffected by all energy passing through it, but will measure directly the magnetizing or "wattless" volt amperes.

Such an arrangement is extremely simple on two-phase systems where the series coil, for example, should be connected in the leads of phase *A* and the potential coil across the terminals of phase *B*. On three-phase systems any one of the well known ways for obtaining a quarter-phase displacement may be used to supply the potential winding. Induction wattmeters for single-phase circuits have their potential coils connected through devices with high inductances so that the coils get currents as closely as possible to 90 deg. out of phase with the impressed e. m. f. To adapt them for measuring the "wattless" instead of the energy component, all that is necessary is to remove these devices and to connect the potential coils straight across the mains with a non-inductive resistance; meters modified in this manner will be unaffected by the energy loads passing through them, but will respond to and measure what might be called the "wattless" volt-amperes. On the other hand, motor-meters of commutator types, such as the Thomson recording wattmeter, have their potential coils connected non-inductively across the mains. To adapt them for the purpose described above, the potential coils may be supplied with currents displaced by inductances or otherwise through a quarter-phase.

In running alternators in multiple it is well known that the division of the load cannot be adjusted by varying the field excitation of any one or more of them, nor can it be measured by ammeters. Any variation of the field excitation only causes a change of the voltage, and a cross-magnetizing current from one machine to the others demagnetizing one and building up the fields of the others to an equality. This cross-magnetizing current should, of course, for minimum heating, be kept as small as possible, and the only way to measure it with any degree of accuracy is by means of instruments modified as pointed out above.

Marconi's Recent Work in Wireless Telegraphy.

The accompanying illustrations are reproductions of photographs showing the apparatus and mast used at South Foreland by Marconi in his recent successful experiments in transmitting signals a distance of thirty miles across the English Channel. The interior view shows the apparatus installed, two sets of coherers, an induction coil, transmitting and receiving apparatus being fixed upon a small table. The key is of a new design, and when not in use automatically connects up the receiving instrument. The length of the spark used was about three-quarters of an inch. In addition to a Morse recorder, the signals were also struck on a bell, and thus read by sound. A speed of from 14 to 15 words per minute was obtained with inexpert operators, but some of the French operators were able to receive over 20 words per minute. The pole or mast is about 150 feet high, in three lengths, as shown in the engraving.

In a room closely adjoining the wireless apparatus is installed the generating plant for the lighthouse lamp, consisting of magneto-electric machines which, by the way, have been running for about 27 years, with only a switch, and not even a measuring instrument interposed. The Marconi apparatus was in no way disturbed even when brought within a few inches of the electrical machinery.

Marconi has recently stated that he knows nothing of any serious

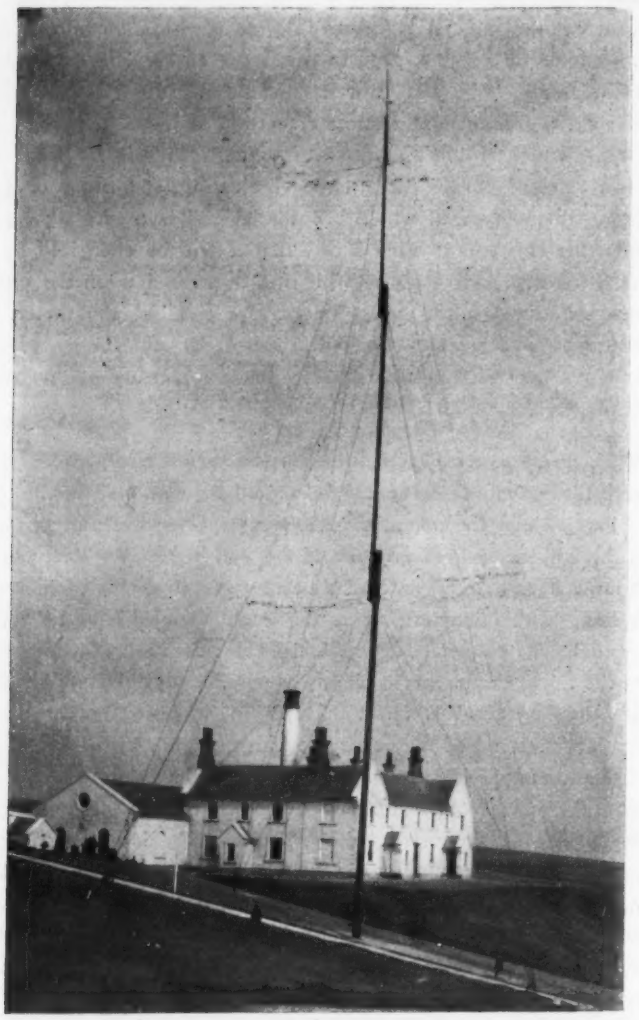

FIG. 1.—MAST FOR WIRELESS TELEGRAPHY AT THE SOUTH FORELAND.

attempt being made to establish wireless communication between Ireland and New York. He expressed the conviction that real progress could only be made by short stages, and that he was determined to undertake no share in any experiments likely to bring the system into disrepute through complete or even partial failure. He agrees with Dr. Fleming that wireless telegraphy is quite unlikely to take the place of wire telegraphy for long distance work, but considers that the system is now available for connecting islands or places separated by sea up to a distance of 60 or 70 miles. Marconi also stated that he regarded the recent fall in the value of the securities of the great cable companies as unjustifiable by any successes yet attained by wireless telegraphy.

Marconi has succeeded in so regulating his transmissions that signals intended for the French coast do not affect the receiver on the Goodwin's lightship, and vice versa. In some recent experiments he transmitted from a ship in the channel, signals to South Foreland, Goodwin's lightship and to the station at Wimereux, France, and it was found that any one of these stations could be successfully

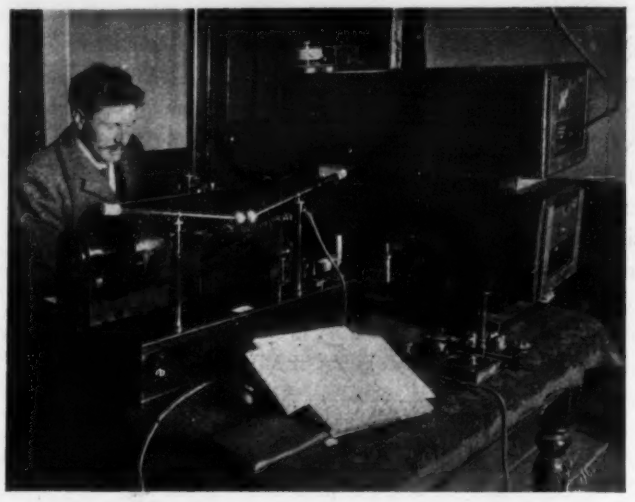

FIG. 2.—INSTRUMENT ROOM AT THE SOUTH FORELAND LIGHTHOUSE.

singled out. As a further test messages were sent simultaneouly from Boulogne, Wimereux and the lightship to the South Foreland, where only the Wimereux message was received, as intended.

Electro-Pneumatic Controlling System.

A patent containing 43 claims and 23 illustrations was granted May 2 to George Westinghouse on an electric-pneumatic system for actuating and governing the movement of mechanical or electro-mechanical devices, and especially for application to electric railway motor controllers. The object of the invention is to provide a simple, compact and efficient means for utilizing fluid pressure and so applying the same to a movable device as to effect a step by step movement of the same in one direction, and a complete stroke movement in the opposite direction. A further object is to provide means for advantageously utilizing fluid pressure in the operation of an electric motor controller or a number of such controllers synchronously, and to provide electromagentic means to control from a more or less distant point or from any one of several points, the fluid pressure and actuating mechanism to which it is applied. Another object of the invention is to so combine and connect the controlling system with an air-brake as to make the two systems practically co-operative, and as simple and compact in combination and arrangement as is consistent with the service to be performed. The fluid pressure is supplied either from the brake train pipe or from a main reservoir on the same car with the controller, the necessary valves being actuated and controlled by an electromagnetic system. The arrangement is such that the corresponding valves of each controller operating mechanism in service may be simultaneously operated from any selected point or any car in the train, or a single car may be operated with the same facility. The only couplings necessary in addition to those employed in the train by the air-brakes and heretofore in use, are those for the electric conductors which carry the current for energizing the electromagnets of the system.

X-Rays Burns in France.

An interesting defence was made in the case of a suit for damages in Paris for alleged injury from X-rays. Some time ago a doctor who was treating Mme. Mochert, a young woman, for a affection of the thigh joint, attempted to photograph the seat of the trouble with the Röntgen rays. It was subsequently noticed that stripes appeared on the skin, which was apparently burned. This burn resulted in a wound that caused long illness, and Mme. Mochert sued the doctor for 5000 francs damages. One of the witnesses, Dr. Bardet, secretary of the Societé Thérapeutique, testified that burning would result in rare instances from the use of the Röntgen rays. Everything depended on the patient's physical condition.

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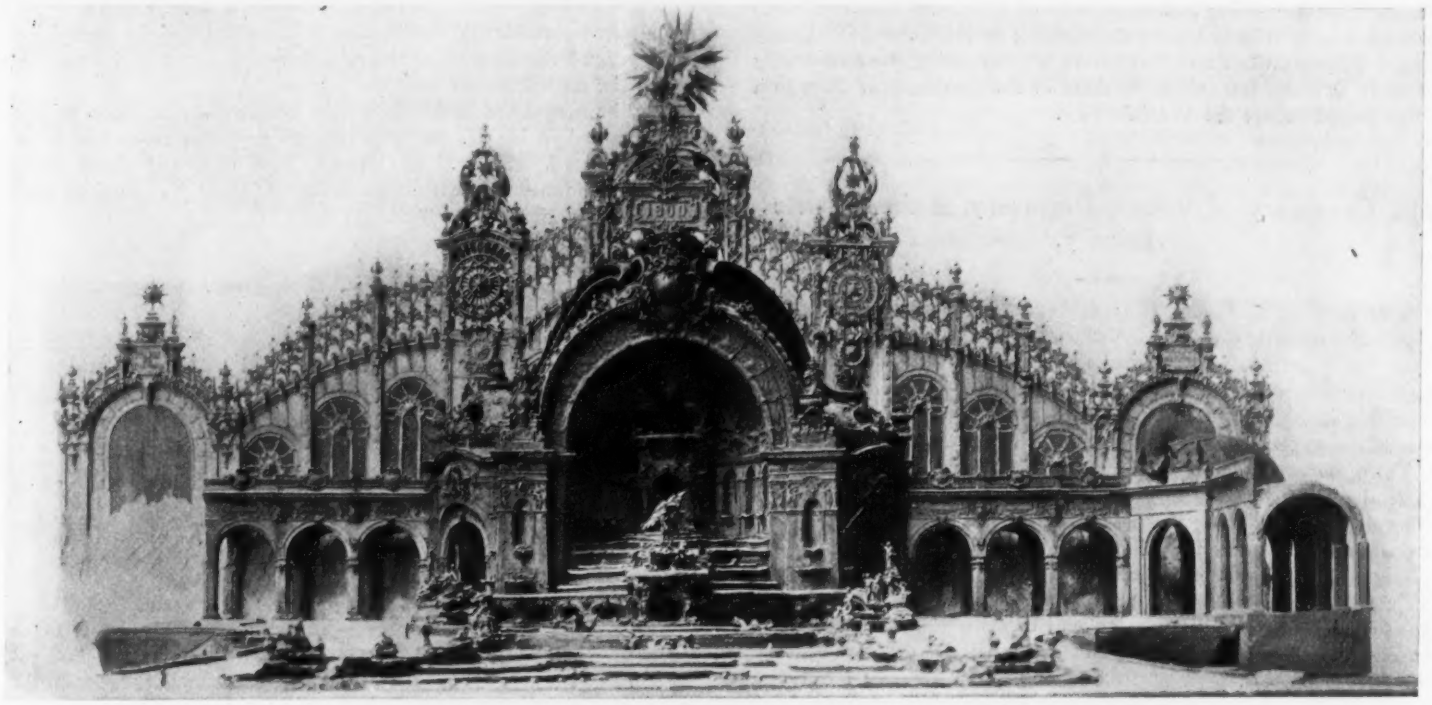
Electricity Building for the Paris Exposition.

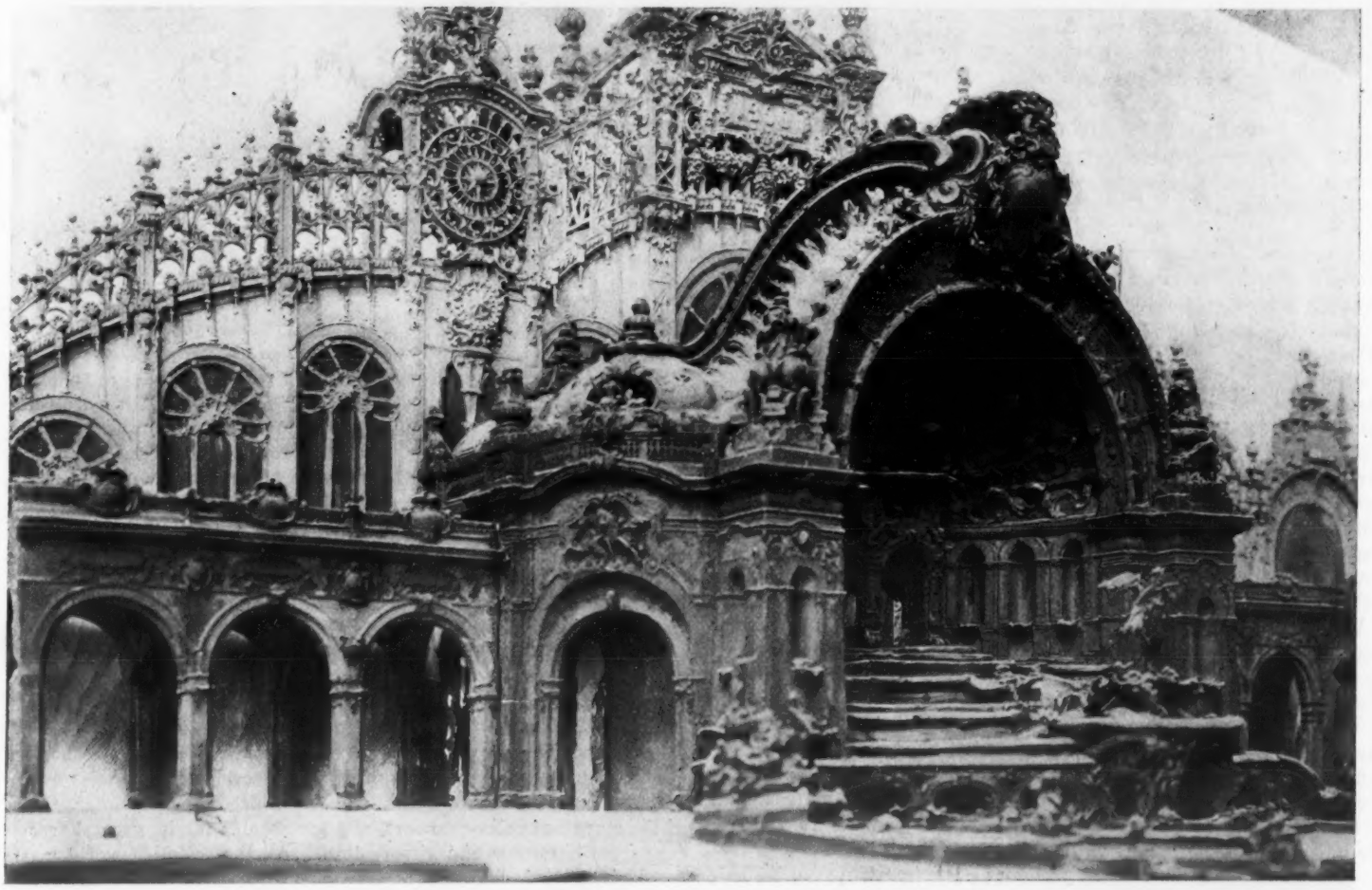
BY JAMES S. ANTHONY,
Assistant Director of Machinery and Electricity.

THE electricity building at the Universal International Exposition at Paris in 1900 will probably be the most elaborate and ornate structure ever erected for a similar purpose. It occupies a commanding site on the Champ de Mars at the end of the vista from the Eiffel tower, and will be the most striking building seen on entering that portion of the Exposition grounds.

The "Chateau d'Eaux," a most elaborate fountain of colossal size, occupies the centre of the facade and constitutes its most imposing feature. Above and on either side of this rises the delicate tracery of the superstructure, crowned by an illuminated star which will be visible from all parts of the grounds.

The material used in its construction is staff relieved by transparent enamels, the whole to be treated in color and most brilliantly





ELECTRICITY BUILDING, PARIS EXPOSITION.

illuminated. This building is to contain all the electrical exhibits except those illustrating electric traction and automobiles, which are to be placed in the Park of Vincennes. Some general machinery will also be placed in the electricity building, but it is expected that most of the heavy exhibits of this class will be placed elsewhere.

The United States section for electricity machinery in this building consists of a very advantageous space on the main floor, a generous section of the Salon d'Honneur which will be devoted to exhibits of a purely scientific or historical character, and a good sized gallery space in addition, the three aggregating about 48,000 square feet gross.

All the buildings on the Exposition grounds are well under way, and staff is already being placed on some of them. As compared with the same length of time before the opening of the Columbian Exposition at Chicago, the Paris Exposition is progressing most favorably and there is much less left to be done in the coming year than in a similar period before the World's Fair.

The Centenary of Volta's Discovery of the Electric Battery.

ON May 15 at Como, Italy, an exposition opens to celebrate the discovery there by Volta of the electric pile, and steps have been taken to place American electrical engineers and electricians in touch with this interesting event. A fund of several hundred dollars has been raised by the telegraphers of this country towards the expenses of a bronze wreath which is to be attached to the Volta monument, and a delegate has been sent by the operators to attend the Telegraphic Conference which will be held at the close of this month and during the first days of June at Milan and Como. This week at the Electrical Exhibition in Madison Square Garden, on May 13, the New York Electrical Society will conduct exercises in celebration of the interesting anniversary and occasion, and messages of esteem and congratulation will be sent from the meeting to the Como Exposition and to the electrical societies of Italy, as well as to King Humbert.

Few events in electrical history have been more striking and momentous than Volta's discovery, yet it is a little singular that the same century which began with such high hopes of obtaining illimitable current from the primary battery should have witnessed its practical supersession by later methods without which, indeed, the modern work of electricity would have been utterly impossible. As one of the foundations for the instantaneous communication of intelligence over long distances, the voltaic cell soon established its immense value, but when the tests came of its use in lighting and power, requiring current of large volume and high potential, the expense of such a source, as every one knows who is familiar with electrical development, proved at once to be an insuperable objection. Even to this day one hears of primary batteries that can compete with dynamo-electric machinery, but they become rarer and rarer and are not often urged upon public attention with serious and honest intent. The great arts of telegraphy and telephony, essentially the children of the Voltaic cell, depend upon it less and less for the current which operates their apparatus, and the whole trend of the electrical movement is towards entire dependence upon the dynamo. Of course, the varied and scattered uses of electricity still require primary batteries in infinite number, but it is a curious fact that as the century began with its hopes based on the primary battery, so the century closes with a recognition of the fact that the storage battery in which the same underlying chemical principles govern the action, is the key to many more new electrical arts that the coming one hundred years are to yield in rich profusion.

While these ideas are now commonplaces to most of our readers, and while the life story of Volta has been so frequently rehearsed as to offer few points of novelty, the interesting occasion is sufficient excuse for a brief review of Volta and his times. Volta was born at Como, Italy, of a noble family, in 1745, and at the age of 29 became Professor of Physics in the college of his native town. Five years later he was called to occupy the same chair in the faculty of the University of Pavia. While at Como he invented, in 1775, the electrophorus, and later divised the straw electrometer to replace the pith bal. in experiments with static electricity. He was also the inventor of the first absolute electrometer. His instrument embodied the fundamental idea which more than a half century later was applied in the Thomson absolute electrometer. The condenser at one time in his earlier career occupied his attention, and he produced a plate form as a substitute for the Leyden jars.

Volta was attracted to the study of electricity by reading the celebrated memoir of Galvani, published in 1791, and giving the first account of the Bolognese professor's discoveries in what he termed "animal electricity." Very soon after, Volta attacked the conclusions of Galvani as to the cause of the phenomena described, and offered instead his contact theory of the origin of electrical force and its manifestation. Galvani's theory, it will be remembered, was that there always exists in the bodies of animals of every species an electricity; that a muscle of the body is a Leyden jar, while a nerve plays the part of a simple conductor; and that when a muscle and a nerve are connected metallically, equilibrium is disturbed and the electricity circulates from the interior of the muscle to the nerve, and from the nerve to the muscle across the "metallic arc."

It may be mentioned incidentally that before Galvani, such effects as he obtained in his famous experiments with the frogs had been obscurely noted. Sulzer, a German, had observed these phenomena in connection with the sense of taste by putting two

COUNT ALESSANDRO VOLTA.

dissimilar metals on the tongue, twenty-three years before Galvani, and Galvani's work was even more closely paralleled in 1786 by a Neapolitan professor named Cotugno, one of whose pupils got a shock from a dead mouse he had under his scalpel. But while these things were anticipatory, they led no whither, and to Galvani will always belong the credit for the historical point of departure and for the precise formulation of a theory that Volta now proceeded to demolish—in so doing, however, discovering the useful pile, just as Saul hunting for his father's live stock found a kingdom.

Volta contended that no electricity specially resides in animals. He held that the simple contact of two dissimilar metals disengages electricity, and that therefore the phenomena described by Galvani could be explained with reference merely to the metals employed in the experiments, for the reason that these metals applied to the parts of the animal containing juices, and, thus possessing conductive properties, could of themselves and of their own intrinsic quality disturb electrical equilibrium and thereby set electricity in motion.

Thus began one of the greatest of the scientific controversies ever indulged in by the philosophers, and one which, perhaps, on account of the spread of polite manners, was remarkable for its general freedom from bitterness and vituperation. All the scientific world was deeply interested, the seats of learning were agitated, and the savants and experts lined up everywhere for the conflict. In short, the

learned of the day divided themselves into two camps, one committed to "contact electricity" and the other to "animal electricity." A society was formed at the University of Bologna to uphold the theory of Galvani, while one at the University of Pavia undertook to maintain that of Volta. Though many great leaders of thought took part in the controversy, interest centred in the principals, who for five or six years alternated in publishing papers sustaining their respective views, the victory appearing to lie at times with one and at times with the other. A French writer has said finely that the memorable scientific debate between these two great minds will always live in the history of science, not only on account of the importance of the questions involved, but also because of the courtesy and dignity of tone by which the controversy was characterized. It is one of the happy episodes of the present Volta celebration at Como that on June 6, the Congress of Telegraphy will proceed also to Bologna to deposit a wreath of bronze at the base of the statue of Galvani there. Thus should the search and struggle for truth always end in the peaceful harmony of its votaries.

The discovery of Volta consisted mainly in multiplying couples formed of disks of copper and zinc soldered together in alternate relation—the couples being separated by damp bodies, such as disks of cloth wetted with a saline or sulphuric or similar acid solution—and so placed that a zinc disk is always between two copper disks and vice versa. A tension is thus produced between the terminal disks of the pile sufficient to ensure effects similar to those obtained from the Leyden jar, which until then had been, with its static generator, the only considerable source of electricity. To this invention, whose greatest significance lies in the accompanying discovery of current electricity, we owe to entire development of modern electrical science and industry. Volta also devised not merely the crude "pile form," but the cup or cell type of battery since so universal in application industrially. He took a number of cups filled with brine or acid solution, and dipped into them a number of compound strips, the zinc portion being plunged in one cup and the copper portion into the other. Each cup thus contained a voltaic couple, and out of this was evolved the modern battery. The demonstrations Volta was then able to give went so much further than the merely slight results obtained with the clumsy pile that he settled the Galvani controversy most absolutely and made himself immortal.

It is needless to say that Volta's discovery was not all the truth; but the other steps soon followed. He wrote on March 20, 1800, to Sir Joseph Banks, president of the Royal Society of England, and again in June, and the data of his letters being communicated to Messrs. Nicholson and Carlisle, they repeated the pile experiments, noticing immediately the fact that there was a decomposing effect of the current on water they had used. This brought with it the corollary of chemical action. It should be noted, however, that in 1792, Fabroni, a Florentine chemist, attributed the effects noticed by Galvani and Volta, not to animal electricity nor to the simple contact of dissimilar metals, but to chemical action. This view received little consideration for some years, the controversy concerning the two older theories apparently absorbing exclusive attention. The invention of the voltaic pile necessarily led, as already indicated above, to the study of the chemical effects which accompany the production of voltaic currents, and the construction of batteries in which the generation of currents of considerable quantity intensified these effects, soon led to the general acceptance of that theory in one form or other. The contact potential theory that current is generated by mere contact was early cast aside.

VOLTA BEFORE NAPOLEON.

The modern view of voltaic action, as stated by Dr. Oliver Lodge, is that electromotive force is not due to mere contact, but, in the copper-zinc cell, for example, to the greater affinity of oxygen for zinc than for copper. A piece of isolated zinc is 1.8 volts below the potential of the atmosphere and copper .8 volt. When the two metals are connected, they necessarily become of the same potential and the equalization of potential is effected by the rush of electricity across the junction, whereby the zinc receives a positive charge and the copper a negative charge. In air, the equalization of potential is effected in an instant, while in a liquid the negative charge is continually being carried back from the copper to the zinc, and the positive

charge from the zinc to the copper, by chains of atoms, so that the potential is here never equalized.

Napoleon took a profound interest in Volta's discovery, his intuition as to its possibilities being as swift as usual. His admiration of the philosopher with whom he could well claim kindred nationality was always lively, and apparently no opportunity was lost to manifest it. When, in 1796, Pavia was pillaged by French troops, Napoleon gave orders to spare the house of Volta, and French army officers took upon themselves the duty of guarding it personally in order to more completely assure protection. Later, Napoleon invited the Italian professor to Paris, and he attended the sitting of the Institute at which Volta explained the principle of the voltaic cell, joining in

STATUE OF VOLTA AT COMO.

the discussion which followed. One of our illustrations in this article is from a picture by the famous Italian historical artist, Bertini, representing an interview in which Napoleon and Volta participate, with the pile or cell as a topic of conversation and discussion. Volta was in fact, like Voltaire, Franklin and other leading philosophers of his time, quite a man of the world, being known throughout Europe in the highest society not merely through his work but by his travels. Moreover, Italy was then even more than now part of the grand tour, and no philosopher thought a trip to Italy complete which did not include a visit of homage to the illustrious Volta. He was a poet, he took an interest in agriculture, and is said to have introduced the culture of the potato into Lombardy. By Napoleon he was made a Count and Senator of the Kingdom of Italy, and from the same hands he received the Order of the Iron Crown. He was also made a member of the Legion of Honor and a Foreign Associate of the French Institute. He was also a member of the Royal Society, receiving from it as early as 1794 its Copley medal.

For several years in the present century, Volta occupied the chair of Natural Philosophy at Pavia, when he retired to his native town, dying there in 1827. He spent his last days in peace and honor. His work was done, and having little taste for mathematics or chemistry, he was hardly in touch with the larger fields he had opened up to electricity, as well as too old to enter upon the new domain of electromagnetism for which Faraday was beginning to do that which he had himself done in another branch of electricity so thoroughly and admirably. Popular fancy always likes to associate great events and discoveries with a personality, and in this case it is not far wrong when it pictures Volta handing the torch of knowledge to Faraday, as light givers in electricity.

A New Transformer Diagram.

The simplest alternating-current apparatus is the alternating-current transformer. While this is true, the theory of the transformer is not simple; many practical men who thoroughly understand the alternating-current generator and can solve any practical problem which may come up in connection with the flow of an alternating-current in a series circuit are at a loss how to proceed when the transformer is involved in the problem.

Under the title which heads this article is given in the Physical Review* of 1899 the theory of the alternating-current transformer, in which the solution of any transformer problem is reduced to that of a problem in a series alternating-current circuit. The article in question is too mathematical for most practical men; the purpose of this will be, therefore, to give the conclusions reached as free from mathematical formulas and in as practical a form as possible.

The author starts with the equations of the primary and secondary electromotive forces and magnetic flux, which were first used by Hopkinson, and obtains expressions for the instantaneous values of the three varying quantities—primary and secondary current and the resultant magneto-motive force.†

In Fig. 1 the relations of the quantities given in the footnote are shown graphically. As will be seen, the three varying quantities

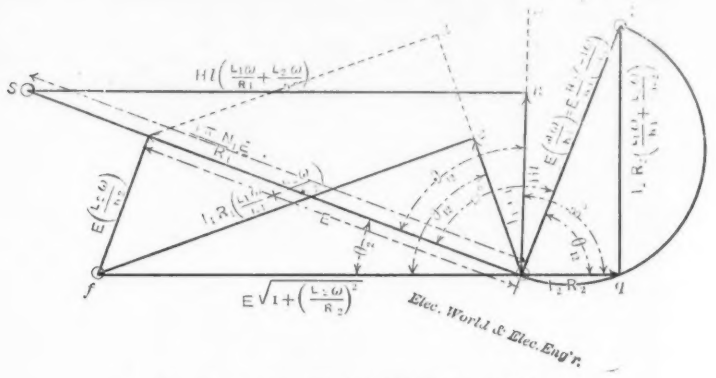


FIG. 1.—A NEW TRANSFORMER DIAGRAM.

form three similar triangles. Let us look for a moment at the secondary e. m. f. triangle, *o p q*.

The hypothenuse, which gives the impressed e. m. f. on the secondary (it is the apparent e. m. f., but may be taken as the real value), is at right angles to the primary impressed e m. f., and is,

*A New Transformer Diagram. By Frank G. Baum, Physical Review, February, 1899.

†L_1 and L_2 are the self-induction of primary and secondary coil respectively, and N_1 and N_2 the respective number of turns. R = primary resistance, R_2 = secondary resistance, including load. M = mutual induction of two coils. $\mathfrak{H}$=strength of magnetic field and l= length of magnetic circuit. The maximum values are as follows:

$$\Phi_{1,2} = tan^{-1}\left(\frac{L_1\omega_1}{R_1} + \frac{L_2\omega}{R_2}\right).$$

$$\Phi_2 = tan^{-1}\left(\frac{L_2\omega}{R_2}\right).$$

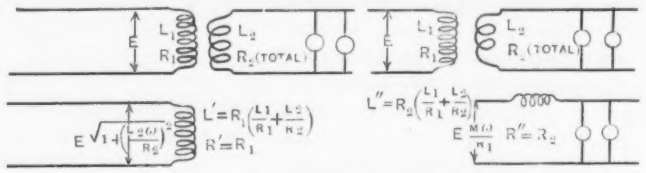
$$I_1^2R_1^2\left[1+\left(\frac{L_1\omega}{R_1}+\frac{L_2\omega}{R_2}\right)^2\right] = E^2\left[1+\left(\frac{L_2\omega}{R_2}\right)^2\right] = E^2\sec^2\Theta_2.$$

$$I_2^2R_2^2\left[1+\left(\frac{L_1\omega}{R_1}+\frac{L_2\omega}{R_2}\right)^2\right] = E^2\left(\frac{M\omega}{R_1}\right)^2 = E^2\left(\frac{N_2}{N_1}\right)^2\left(\frac{L_1\omega}{R_1}\right).$$

$$\mathfrak{H}^2l^2\left[1+\left(\frac{L_1\omega}{R_1}+\frac{L_2\omega}{R_2}\right)^2\right] = \left(\frac{4\pi N_1E}{R_1}\right)^2.$$

therefore, constant in direction, and has a constant magnitude $\frac{E M \omega}{R}$. The impressed e. m. f. on the secondary being constant, and the other two sides of the triangle being independent of any variable quantity in the primary, we may, for the solution of problems in the receiver circuit, disregard the remainder of the diagram; that is, we may think of the secondary and its load as being connected to a dynamo giving a potential $\frac{E M \omega}{R}$, an additional inductance, $\frac{L R_2}{R_1}$, being considered as connected in series with the inductance of the secondary coil of the transformer. This is shown diagrammatically in Fig. 3.

From the triangle o p q we may also discuss the regulation of

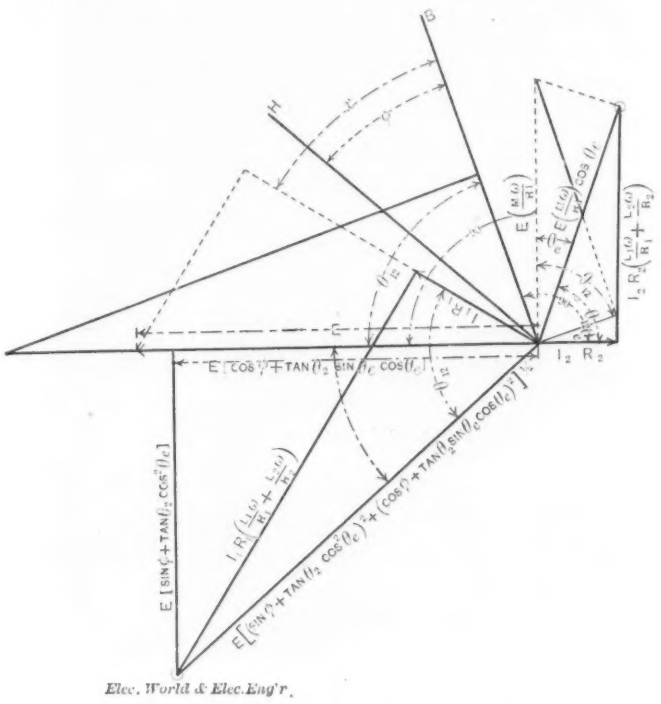


FIGS. 2 AND 3.—A NEW TRANSFORMER DIAGRAM.

the transformer; that is, the change in voltage at the terminals of the secondary for different values of the load. The following conclusions may be drawn from the figure: (a) An increase or decrease in the primary e. m. f., the mutual induction of the coils, or the frequency with an increase of load will increase or decrease the secondary voltage. (b) An increase of the primary resistance as the load increases will decrease the secondary voltage. (c) A decrease in R_2—that is, an increase in the load—increases Φ_{12}, which, as will be seen from the diagram, decreases the secondary voltage. (d) An increase of the secondary current will, of course, cause an increase in the drop of potential across the secondary windings.

The drop in voltage at the secondary terminals is due, then, mainly to (d); (c) does not affect the regulation materially. An increase in the magnetic leakage as the load increases would act like a decrease in the mutual induction and, hence, cause a fall of potential at the secondary terminals.

As will be seen from Figs. 1 and 3, for the solution of problems in the transmission circuit, the transformer and its load may be replaced by a single coil; the e. m. f. of the dynamo being considered as raised to the value $E = \sqrt{I + \left(\frac{L \omega}{R_2}\right)^2}$, the primary inductance being replaced by one having the value $L_1 + \left(\frac{R}{R_2}\right) L_2$. Since a transformer may be replaced by a single coil we may, by this device, solve the problems of the multiple transformer circuit, or the problems arising out of successive transformation. The manner of attacking either problem will at once suggest itself.



Elec. World & Elec. Eng'r.

FIG. 4.—A NEW TRANSFORMER DIAGRAM.

The triangle of magnetomotive forces is instructive, as it shows the true reason for the drop in the secondary voltage as the load is increased.

The above discussion is on the assumption of no hysteresis and a non-inductive load. In all closed circuit transformers, however, there is an angle of lag between the magnetomotive force and magnetic flux. This angle varies from zero (practically) in the open-

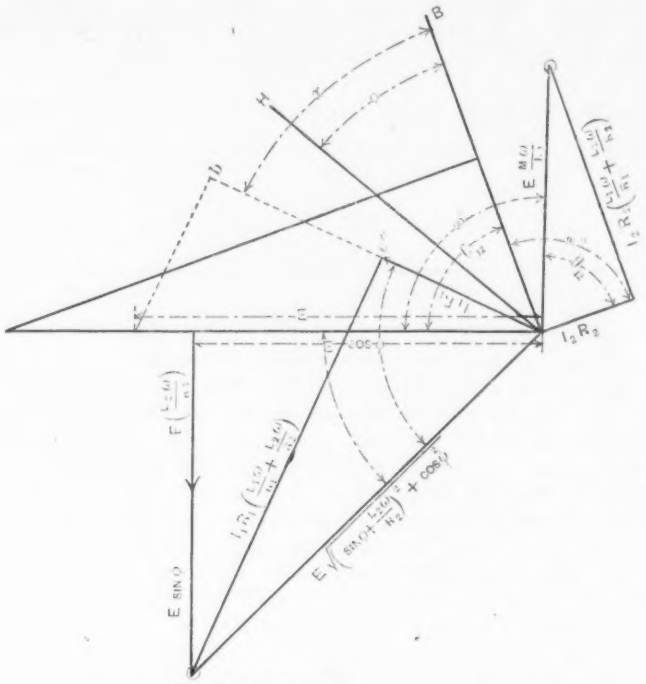


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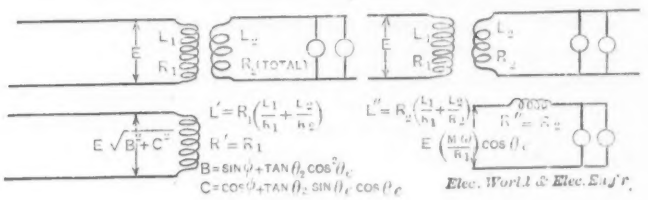
FIG. 5.—A NEW TRANSFORMER DIAGRAM.

circuit transformer (hedgehog) to as much as 70° in some of the closed-circuit transformers. Fig. 4 shows the diagram which results when the hysteretic angle is taken as φ. It is at once seen that hysteresis does not affect the secondary in any way. The only change from Fig. 1 is in the primary e. m. f. triangle; this shows an increase in the power drawn from the dynamo for a given amount of power delivered to the secondary.

Fig. 5 shows the diagram for an inductive secondary load. Fig. 6 shows the manner of replacing the transformer by a single coil for the solution of problems in the transmission circuit, and Fig. 7 the manner of replacing for the solution of problems in the transmission circuit. Fig. 7 is the same as Fig. 6, except that the terminal potential is reduced by the factor case. The effect of an inductive load on regulation is clearly shown. Fig. 4 applies to all cases; it will reduce to Fig. 3 for a non-inductive load and to Fig. 1 if no hysteresis is assumed.

It will be seen from Figs. 1, 4 and 5 that the secondary pressure is practically 180 degrees behind the primary pressure for all loads. In order to measure the power delivered to the primary, therefore, it is not necessary to place the voltmeter coil across the primary



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FIGS. 6 AND 7.—A NEW TRANSFORMER DIAGRAM.

mains. The current coil of the wattmeter should be connected in series with the primary and the voltmeter coil connected to an unloaded transformer. By multiplying by the ratio of transformation, correct readings of power may be obtained. The power factor of the primary for different loads may be obtained in the same way.

Phase Angle Measurements.

BY EDWIN PLACE.

IN the *Philosophical Magazine* of May, 1897, Lord Rayleigh described a form of soft iron galvanometer, as he termed it, for measuring the phase angle between two alternating currents and a reprint of the same article appeared in the *London Electrician* of June 4, the same year. The characteristic feature of the instrument was a soft iron needle instead of a magnetized steel one as in an ordinary galvanometer. This needle which in his instrument was simply a short piece of iron wire, was suspended by a glass fibre between two coils in such a manner that when freely at rest it took a position of approximately 45 degrees with the common axis of the coils.

When an alternating current is sent through either coil of such

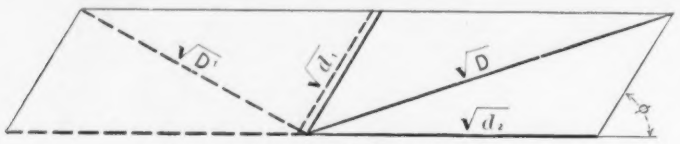


FIG. 1.—PHASE ANGLE MEASUREMENTS.

an instrument, the needle is turned toward parallelism with the axis an amount depending on the strength of current and the distance apart of the coil and needle. If the deflection is small and a mirror and scale be used to magnify and measure it, the scale deflections may be used to determine the current strength. When the instrument is used to measure phase angle between two currents, the deflection is observed when the current in each coil acts separately, each giving a separate scale reading, and also that deflection when both are acting at the same time. From these three deflections, the author states, can be deduced the phase angle.

To see how, by this method, the phase angle may be found between two currents when these follow the sine law, it will be sufficient to deal only with the magnetic fields which the currents produce. The field due to an alternating current is, at any instant, strictly proportional to the current, and is in phase with it and also with the e. m. f. causing it, if the circuit upon which it is impressed contains no inductance or capacity. If each coil of the instrument is placed at a fixed distance from the needle, it is not necessary to consider these distances or the constants of the coils when we confine our attention to the fields they produce at the needle. This simplifies ideas, and is the more direct way of looking at the matter.

The alternating field produces an alternating polarity in the needle in phase with it, and the reaction between the field and the temporary poles thus induced is to turn the needle more into line with the field itself. The couple tending to turn it will at each instant be proportional to the square of the field strength for weak values of the latter. In consequence of the inertia of the needle system and the rigidity of the suspension fibre, the needle finally settles down to a steady position as though the field were uni-directional, and if the deflection is small it will be proportional to the mean square value of the field.

Calling f, the square root of the mean square value of the field at the needle due to the current in one coil and d, the deflection.

$f_1^2 = A\,d$, where A is a constant depending on the magnetic quality and dimensions of the needle and the nature of the suspension. Similarly, for the other coil

$$f_2^2 = A\,d_2$$

If now both coils act together and F be the resultant field $F^2 = A\,D$, D being the deflection. These relations hold whether the currents follow the sine law or not provided the needle be short and the lines of force in its neighborhood are straight. When they follow the sine law we know that F regarded as a vector is the sum of the vectors f_1 and f_2, or algebraically.

$F^2 = f_1^2 + f_2^2 + 2\,f_1\,f_2\,\cos\phi$ where ϕ is the phase angle between f_1 and f_2. Putting in these values we have,

$$A\,D = A\,d_1 + A\,d_2 + 2\,A\,\sqrt{d_1\,d_2}\cos\phi$$

or

$$D = d_1 + d_2 + 2\,\sqrt{d_1\,d_2}\cos\phi \quad . \quad . \quad (1)$$

If the current in one of the coils be reversed by changing the terminals the operation is equivalent to changing the phase angle of it with respect to the other 180 degrees. Hence we have, calling D' the corresponding deflection,

$$D' = d_1 + d_2 - 2\,\sqrt{d_1\,d_2}\cos\phi \quad . \quad . \quad (2)$$

From either of these last two equations ϕ can be computed. Subtracting the last from the previous one we have

$$D - D' = 4\,\sqrt{d_1\,d_2}\cos\phi, \text{ whence } \cos\phi = \frac{D - D'}{4\,\sqrt{d_1\,d_2}} \quad . \quad . \quad (3)$$

adding (1) and (2)

$$D + D = 2\,(d_1 + d_2) \quad . \quad . \quad (4)$$

an expression which is independent of the angle. If the coils be moved to new distances from the needle the scale readings will be changed, but these equations will still hold for a given angle. The angle may be found graphically by constructing a parallelogram with sides $\sqrt{d_1}$ and $\sqrt{d_2}$ such that the diagonal is either $\sqrt{D}$ or $\sqrt{D'}$. These lines will then represent to scale the relative magnitude of the fields acting on the needle, or the currents in the coils and the angle between the sides will be that required.

Thus in Fig. 1, the heavy lines show the relations given by eq. (1), say, and the dotted ones by eq. (2).

It is obvious that when the two currents are in the same phase and $\phi = 0$, $\sqrt{D} = \sqrt{d_1} + \sqrt{d_2}$ and when in opposite phase $\sqrt{D'} = \sqrt{d_1} - \sqrt{d_2}$ i. e., the resultant field in either case is the algebraic sum of the two components. When ϕ becomes 90° D and D' are each equal to the sum of d_1 and d_2 since in this case the parallelograms become equal rectangles and the square of the diagonal equals the sum of the squares of the sides opposite.

From the elementary theory of the instrument given, only the numerical value of the angle can be found and there is nothing to show which one of the currents is in advance of the other. The lag or lead must be deduced from other considerations.

Not long ago the writer constructed an apparatus somewhat on the plan of Lord Rayleigh's to see if it would make a convenient instrument for laboratory use that might be relied upon in general, for phase angle measurements. Although it has not yielded results wholly satisfactory or consistent with the theory of it as given by the eminent physicist, yet it may be of interest to some to learn something of its actual performances. The form which it finally assumed after some modifications is illustrated in Fig. 2. The view shows it arranged for measuring the angle between current and e. m. f. supplied to any translating device. The coils, one for current and the other for the voltage, were both wound on wooden spools, the mean diameter of coils being approximately 11 cms; the C coil having 8 turns of No. 10 B. & S. copper wire, the V coil 80 turns of No. 30 g. s. wire and resistance 170 ohms. These both were mounted in place of the regular coils of a Störer galvanometer, and admitted of being moved to various distances from the needle as suited the conditions best. The needle consisted of two pieces of

FIG. 2.—APPARATUS FOR PHASE ANGLE MEASUREMENTS.

very soft iron wire 0.6 cm. long and 0.8 m. m. diameter laid together one above the other. To these were attached a light concave mirror and a mica vane to damp the oscillations. The whole was enclosed in a wooden case and suspended by a fine bronze ribbon about 25 cms. long. Readings of deflection were obtained by the image of an incandescent lamp filament reflected from the mirror and brought to focus on the scale 106 cms. or about 830 scale divisions away. In the first trials of the instrument a single piece of ordinary iron wire was used for a needle but the zero was very inconstant with it and the spot of light crept up the scale for some time after the current was turned on and the oscillations had ceased. This trouble entirely disappeared after a better quality of iron wire was used. The complete period of the needle was about 4½ seconds and the air damping was sufficient to bring it practically to rest in half a minute.

The scale was calibrated for each coil by comparing the deflectives with the readings of a Kelvin balance in series with the coil under trial; a separate balance being used for each. Current was taken from a transformer, at 100 volts and varied by using lamps in circuit with the apparatus. Deflections were taken over nearly 300 scale divisions; and when these with the fine scale of the balance were plotted as co-ordinates the line through the points was practically straight, the variation from it not exceeding more than one or two per cent. throughout the whole range. The instrument was compared with the balances from time to time during the subsequent trials of it and showed no appreciable variation in this respect. The deflections, then, could be relied upon as being very nearly proportional to the mean square of the current and therefore to the mean square of the field around the needle. This last statement being true for either coil acting alone it surely must be true also when both are acting at the same time. For the needle feels only the strength of the resultant field around it regardless of the causes which produce that field. From this resultant and its two components, Lord Rayleigh states, the phase angle between the components can be computed, whatever be the form of the current waves of those components. It is upon this point that the writer's experiments with the instrument seem to cast some doubt.

Numerous trials were made of phase angle between the voltage and current supplied to circuits of different inductances. In all such cases the connections to the instrument were arranged in general as shown by diagram in Fig. 3. C and V are the current and voltage coils respectively, and A the translating device under test.

In the shunt circuit was a reversing key and in the main circuit near the coil was placed a key to cut out that coil and close the line when the voltage readings were taken. The transformer supplying the circuit was some distance from the apparatus and the line resistance was upwards of half an ohm. To avoid changes in voltage and keep the conditions of the circuit as nearly constant as possible current through A was maintained, while C was cut out for voltage readings.

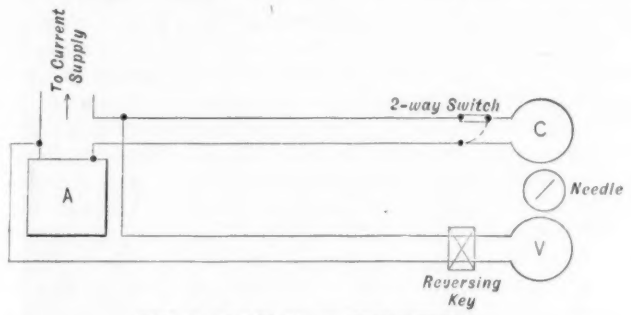


FIG. 3.—DIAGRAM OF CONNECTIONS.

When A was a bank of incandescent lamps it was found that $D + D'$ was, with one or two exceptions, greater than $2\ (d_1 \times d_2)$ and

$$\frac{D - D'}{4\sqrt{d_1 d_2}}$$

greater than 1 by as much as 5% in some cases. Thus with two lamps taking about 1.2 amperes, both coils as near as possible to the needle and 5 lamps in series with the V coil, the following were the scale readings d_1, 38.0; d_2, 30.5; D, 144.5; D^1, 1.0. These give $D + D' = 145.5$ and $2\ (d_1 \times d_2) = 137$. and

$$\frac{D - D'}{4\sqrt{d_1 d_2}} = \frac{143.5}{136.} = 1.05$$

for ***cos*** ϕ. This is one instance out of perhaps, 25, all showing the same uniformity of results, i. e., *cos* ϕ greater than unity.

When A was a circuit of high inductance the results were equally surprising. The large experimental magnet of the laboratory was tried. This one made at the institute is built up entirely of laminated steel and with the eight magnetizing coils weighs something more than a ton. The pole pieces are movable so as to introduce an air gap in the magnetic circuit, if desired. Each coil has 480 turns of No. 10 wire and a resistance of 1.3 ohms and is wound in four equal sections. In one experiment half of a coil was joined in circuit and in another, a quarter coil was used. The voltage at the terminals was in each case 100 very nearly. When the half coil was used and the air space closed up the readings of the instrument were thus: d_1, 14.5; d_2, 30.5; D, 71.5; D'. 25.5. Here $D + D' = 97$ and $2\ (d_1 \times d_2) = 90$, and *cos* ϕ computed from eq. (3) is 0.55 or $\phi = 57°$ the angle

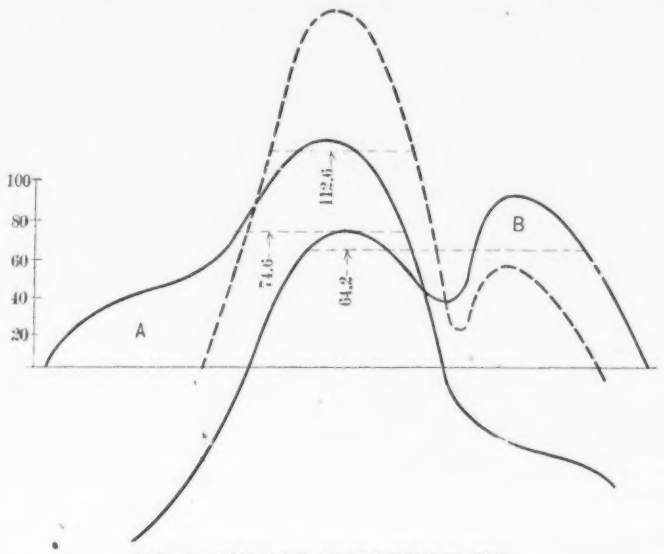


FIG. 4.—EXAMPLE OF CURRENT WAVES.

between the current and applied voltage. A Western wattmeter in circuit at the same time showed 20 watts absorbed in the magnet. The current and voltage shown by the Kelvin balances was .584 amperes, and 100 volts or 58.4 apparent watts. Assuming the ratio of real to apparent watts to be the cosine of the angle this is $20 \div 58.4$ or .35 approx. This makes $\phi = 70°$ nearly. The impedance is $100 \div .584$ or 171 ohms nearly. If we take the resistance of the coil and leads to the instrument as 0.8 ohms, it is very small in comparison to the reactance and we may say that

$$\frac{2\pi n L}{K}$$

or tan ϕ is approximately 171/0.8 or more than 200. making ϕ more than 89°.

The three methods thus give three different values for the same thing. When other arrangements of coils and air space were tried there was a similar disagreement of results. At first it was thought that the self-induction of the fine wire coil might account for some of the disagreement. It was computed from the dimensions of the coil and found to be only .0015 henrys. With 5 lamps in series with it the resistance was not far from 2000 ohms and taking $2\ \pi$ n as 815 for the frequency of 130 per second, the angle between the current in the coil and the impressed voltage amounts to only about two minutes of arc, a negligible quantity. There was no iron used in the construction of the instrument, except the needle, to influence the readings and every precaution was taken to annul all mutual induction between the main and the volt coil circuits. There was found to be a slight action of one coil on the other when they were nearest together (7 cms. apart). To test this a current of 1.4 amperes was sent through the C coil and the voltage induced in the shunt coil measured by a Kelvin balance. The result showed less than 0.6 volt.

An impressed voltage of this amount in either coil could have no important effect on the current in it to change the readings when both coils were acting.

The failure of the instrument to give phase angles in the cases mentioned cannot, in the opinion of the writer, be attributed to defects in its construction or lack of care in experimental details. Either coil acting singly agrees very closely with theory, but when both together act the theory as given by Lord Rayleigh does not seem to apply. He says that eq. (3) above is true whether the currents follow the sine law or not, and that cos ϕ in any case is equal to the

ratio of the true to the apparent watts. This is true for sine currents, but for other forms it is called the power factor. Of course we may call it the cosine of an angle, but this angle will not necessarily be that between the maximum or the zero values of the two currents as is the case with those of the sine form.

In none of the experiments above mentioned was there an agreement of this ratio with the cosine as computed from the instrument readings. The calculations of the angle just made for the case of the magnet are by formulæ based on the assumption that current and e. m. f. are of the sine form, and it could hardly be expected that the results would agree with one another for currents of any other form. It is quite probable that the current through the magnet coming from the transformer was very different in form from the harmonic curve which mathematicians love so well. If this is so it may be the cause of the discrepancies in the values of the phase angle.

To see whether or not the form of the curves has any influence on the result some calculations were made on ideal curves drawn to represent actual current waves, an example of a pair being shown in Figs. 4 and 5. Curves A and B above the horizontal line are the half-waves of each. The dotted curve is the resultant of the two. In Fig. 4, the zero value of B is 90°, or a quarter period behind that of A, and in the other figure it is 90° ahead of A. Supposing A and B to represent the variations of field at the needle due to currents of these shapes in the coils, the resultant curve will show the variations of field when both act together. The squares of their virtual heights would then correspond to the scale readings of the instrument, curve A giving d_1, say; curve B, d_2, and the resultants giving D and D'. These (virtual) ^{2}s were computed thus:

The base line of each curve was divided into ten equal spaces and the ordinates at these points of division measured on the scale of heights shown, and then squared. A new curve was drawn whose ordinates were the squares thus obtained and its mean height found.

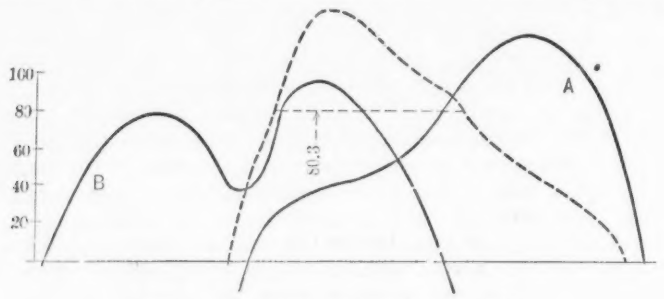


FIG. 5.—EXAMPLE OF CURRENT WAVES.

The square root of this mean measured on the original scale is the virtual value sought. This height is shown for each curve by the distance from the axis of a horizontal dotted line drawn across it. Taking the squares of them to represent readings of the instrument as proposed above, we have $d_1 = 5560$; $d_2 = 4120$; $D = 12{,}680$; $D' = 6540$. Applying eq. (3) to these quantities gives ϕ 71° nearly, whereas the angle between zero values is 90°. Obviously if A and B were sine curves the two resultants would be sine curves alike in all respects, and therefore the squares of the virtual heights would be equal. Here they are not.

It will be seen that these values satisfy eq. (4) very nearly and are quite consistent with the actual instrument readings for the case of the magnet given above. The calculations for the other curves are not yet completed; but three pairs all of different shapes, yet placed like these respecting phase angle, give practically the same results as these. Considering curve A, for instance, it is obvious that there can be found a great number of different shaped ones of the same length giving the same virtual height as A, and among them the sine curve. So also respecting B or their resultant. The equivalent sine curves of A and B can be placed in such phase relation to each other as to give the same resultant curve as the equivalent sine curve of the resultant shown in the figure. This phase angle would be that which the calculations give by using eq. (1), d_1 and d_2 here being the squares of the virtual heights of A and B, D the square of the virtual height of either resultant. The angles thus obtained when ϕ is calculated from D and D', will be supplements of each other provided

In all the trials of the instrument the sum of D and D' was only calculated from D and D', will be supplements of each other provided eq. (4) is satisfied respecting the four readings.

In all the trials of the instrument the sum of D and D' was only a few per cent. greater than $2(d_1 + d_2)$. This fact taken in connection with the results derived from a consideration of the ideal curves leads to the conviction that the instrument gives the angle between the equivalent sine curves corresponding to those dealt with. The power factor in the experiments tried was always greater than the cosine by the instrument, in some instances more than a half greater, where as the value calculated from ammeter and voltmeter readings would approximate zero. None probably of the angles found by these methods would correspond with that between zero values of the currents.

How then shall the phase angle be defined in the generality of cases where current and voltage do not follow the sine law? If the term is needed to express the time relation of two or more different waves there ought to be a definite understanding of its meaning when so used.

Electrical Radiation.—I.

BY ARTHUR V. ABBOTT, C. E.

THE nineteenth century has been termed the "Age of Machinery" and Americans a "Nation of Mechanics," yet it is seventy-five years since the discovery of any *substance* that now bids fair to be of the slightest practical importance. Whence comes, then, this reputation for ingenuity, and why may we be justly proud of our long roll of illustrious inventors? It is because we are learning to utilize not *matter* but *energy*, not the ponderable but the imponderable, not the material but the ethereal, for scarcely a day passes that does not herald either the discovery of some new form of force, or the better application or utilization of an old one.

The ancients believed in four elements—earth, air, fire and water—and further thought that each and all of them were material substances, in the sense this term is now employed. Modern science has not only extended this number and now recognizes some seventy-five different elementary kinds of matter, but has reclassified the universe, relegating on an ultimate analysis, all things knowable into one of two divisions—*matter* and *energy*. What these two final entities really are cannot be defined, nor is it probable, humanly speaking, that their absolute qualities can ever be assigned. For the present we must be contented with defining each in terms of the other—*energy* is that which sets matter in motion, and *matter* is that which is moved by energy. Of either independently of the other, we have not the slightest conception, but under the influence of energy the ultimate particles of matter assume a great variety of motions that, differing from each other, either in their rate or form of wave, give rise to the various familiar manifestations of force, for the greatest of modern scientific generalizations is the statement that all forms of energy are modes of motion.

It is barely 200 years since Lavoisier demonstrated with the balance that in burning, every substance gained in weight, thus effectually disposing of the hypothesis that heat could be of a ponderable nature, and it is but half a century since Meyer and Joule determined its mechanical equivalent. A hundred years ago Dr. Young was engaged in revising the Newtonian proposition that light consisted of material particles projected in all directions from each luminous source, and in substituting therefor the present undulatory hypothesis, Franklin improved upon electrical theories by suggesting the idea of one fluid instead of two; but so persistently clung to its materiality that even at present electricians still talk of *currents* and *flows*, as if electricity was measured by the gallon. Barely ten years have elapsed since Dr. Hertz set himself the task of realizing the Maxwellian prophecy of the existence of electric waves; his success redounding equally to his own skill as an investigator, and to the marvellous analytical insight that enabled the Oxford mathematician a quarter of a century earlier, to predict their existence. Finally, three years ago, Roentgen discovered waves so much finer and more subtile than light that they penetrate with ease bodies whose structure completely extinguishes luminous vibrations. Properly managed, these rays may appeal to the eye, so paradoxically we may see in darkness and look through opacity.

The attention of mankind is attracted to external phenomena by the effect produced on the nervous system, and as different rates of vibration appeal to different nerve centres, a rough classification of wave motion arises, based on sensation. Oscillations of less frequency than sixteen per second produce no impression, but when the pulses occur from sixteen to twenty-four times, the auditory apparatus responds and a low deep tone is heard. As the rapidity of oscillation increases the pitch rises until at about 30,000 or 40,000 vibrations per second, the nerves of the ear fail and the waves pass unnoticed.

In Table I, will be found a rough classification of such air waves as are comprised within auditory limits, thus indicating the compass of that form of energy known as Sound.

TABLE I.—SOUND WAVES IN THE AIR. SPEED, 1100 FT. PER SECOND.

	Designation.	Wave length.	Number of vibrations per second.
Eleven Octaves.	Visible motion		Less than 16.
	Lowest audible sound	68 ft.	16
	Lowest Musical note	34 "	32
	Man's voice	8½ "	128
	Woman's voice	4½ to 2⅛	256 to 512.
	Highest soprano	6 ins.	2,000
	Highest musical note	3 "	4,000
	Highest audible note	1¼ "	40,000

Column No. 3 on the right, gives the number of vibrations per second, No. 2 the Wave Length, while No. 1 may be termed *Designation of the Frequency*, or in other words, the name of the effect that a certain number of vibrations per second produces on the nervous system.

Beyond the rate of 40,000 per second, the mechanism of the ear with all of its marvellous delicacy cannot respond, yet there is no doubt but that vibration of some kind exists, for the olfactory abilities of some animals and the peculiar perception of certain insects makes it evident that there is a wide range of vibration just beyond the audible that organisms more highly equipped than man can detect.

But leaving the grosser air for the infinitely finer and more tenuous luminiferous ether, and conceiving the oscillations to increase from the sluggish rate of 40,000 per second to the enormous speed of 20 trillions, another set of nerves is called into play and the brain responds to the effect as the sensation of heat. As the speed augments the pitch, or intensity of the thermal impression increases, until at a rapidity of 300 trillions the nerves of sensation fail, and a second gap appears, wherein man is again oblivious of any vibratory motion.

Picture now continued increments in the oscillating rate. When 434 trillions are reached the third and last set of nerves is excited and the eye responds to a dull red glow. With ever increasing frequency the pitch of color rises and the successive tints of the rainbow appear, until at the rate of 740 trillions, the nerves of the retina fail and the visible spectrum dies away into the ultra-violet. We can hear through 11 octaves, we can feel through 4 octaves and we can see through 1½ octaves. But is this all? By no means, for beyond the violet, photography has shown the existence of radiation to 1500 trillions per second, and Professor Roentgen with the supreme discovery of cathode radiation has shown the existence of vibration to the inconceivable rapidity of 300 quadrillions per second.

For the sake of a clear conception of the different wave motions as they appeal to the unaided senses, Table II. containing the thermal and luminiferous vibrations may be compared with Table I.

TABLE II.—WAVES IN THE ETHER. HEAT AND LIGHT, SPEED 186,000 MILES PER SECOND.

	Designation.	Wave length.	Number of vibrations per second.
4 Octves Heat Waves	Lowest heat sensation	583 millionths of an inch	20 trillions.
	Highest heat sensation	392 ten " " "	300 "
Light Waves 1½ Octaves.	Red light	471 " " " "	434 "
	Orange light	258 " " " "	500 "
	Yellow light	244 " " " "	520 "
	Green light	207 " " " "	570 "
	Blue light	191 " " " "	634 "
	Indigo	169 " " " "	680 "
	Violet light	165 " " " "	740 "
	Ultra violet radiation	140 to 85 ten millionths or an inch.	870 to 1500 trillion.
	Röntgen rays	Unknown.	Probably 300 quadrillions.

Using the musical fashion of reckoning, the present known range of vibratory motion is comprised within about sixty octaves, while the unaided senses can only cognize about fifteen octaves, or one-quarter of the total compass. Beyond the violet, our knowledge of radiation extends some fifteen octaves, while below the first heat sensation thirty-one octaves exist. The waves in this region cannot affect the unaided nervous system, so that some form of detector is required to bring them to our comprehension, and it is to some of the more recent explorations in this latter field that I invite attention.

Consider the phenomena that take place during an electric spark such as the discharge of an ordinary Leyden jar, the flash of an induction coil or the familiar lightning stroke of a summer thunder shower. By some means the electrical equilibrium of a pair of conductors separated by an insulating medium becomes disturbed. In the present incomplete and unexact state of electrical knowledge, we are accustomed to explain this disturbance by saying that an excess of electricity is accumulated upon one body, and a corresponding deficiency exists on the other; thus, at least, tacitly implying that electricity is a form of matter. While electricity *behaves*, in some respects, as if it possessed some of the *attributes* of matter, such as inertia and momentum, it will probably be found to be no more material than either heat or light, but in default of a better, the present terminology, though faulty, must be used. This disturbance of equilibrium produces stresses in the ether, which gradually increase until the resistance of the dielectric breaks down. We then say that not only does the excess of electricity of one body rush over to fill the deficiency of the other, but the moving electricity carries with it a portion of the rightful quantity belonging to the first body, and delivers it to the second. The conditions are now reversed. Body No. 1 has too little electricity, while body No. 2 has too much, so that the equilibrium is not only restored, but the ether over-stressed in the opposite sense from the first state. A second oscillation takes place; the excess charge of body No. 2 returning to body No. 1, and dragging with it a portion of the electricity belonging to No. 2, and thus the first condition is partially re-established; so wave after wave takes place, gradually decreasing in intensity, for at each swing the overflow of electricity grows smaller and smaller until at last equilibrium is finally restored.

When such a discharge takes place the energy manifested is gradually dissipated; partly in the explosion of the spark; partly as heat expended in raising to incandescence particles of the intervening air, or minute fragments of the conducting bodies torn from them by the violence of the action; partly as light emitted by these glowing molecules; partly as magnetic oscillations set up by the moving electricity as it passes to and fro between the discharging bodies, and *partly* as *radiant energy*, true *electric waves* which do not return to the originating circuit, like the magnetic pulses, but undulate away indefinitely through space, with their burden of energy.

The existence of such electric waves seems first to have been suspected by Dr. Henry in 1842, who found that needles placed in his cellar were magnetized by a discharge of a Leyden jar in the attic. In 1853 Lord Kelvin showed mathematically that the discharge of a condenser should be oscillatory and subsequently Maxwell analytically developed the subject to a greater extent. In 1862 Fedderson, with a revolving mirror proved experimentally the oscillatory character of a Leyden jar spark, and indicated that the velocity was sensibly the same as that of light, while in 1889 Dr. Hertz showed experimentally the existence of such electric waves by reconverting them into the ordinary manifestations of a spark. Hertz reasoned that if a given electric circuit in some part of which a spark was taking place, was able to *emit* electric waves, as a transmitter, a precisely similar circuit ought to *absorb* such radiation as a receiver, and reconvert it into visible scintillations. Many instances of such reciprocal action are well known. Either one of a pair of similar tuning forks, sounding at a distance from its mate, will set the companion vibrating and the ordinary Bell telephone acts equally as a receiver or transmitter.

Electrical Applications in Holland.

In a recent communication to the State Department at Washington, United States Consul Listoe, at Rotterdam, gives communication United States Consul Listoe, at Rotterdam, gives some interesting information regarding electrical enterprises in the Netherlands. There are only two electric railways in operation in that country—the road from Vaals to the German frontier, under the management of the Aachener Kleinbahn Gesellschaft, a little over half a mile in length, and the line from The Hague to Scheveningen, something over six miles. Concessions of franchises must be obtained from the various city governments and from the state, when public highways are to be occupied. Some municipalities—Rotterdam, for instance—seem to be prejudiced against electric railways; in others, however, concessions could doubtless be readily obtained. On the Island of Walcheren, the project of building an electric line from Flushing or Middleburg to Domburg and Vere has long been agitated; but things move slowly in this country, and there would probably be a good opening for the enterprise.

Opening of the Electrical Exhibition at Madison Square Garden.

THE Electrical Exhibition at Madison Square Garden, New York City, under the auspices of the National Electric Light Association, was opened with considerable eclat on the evening of Monday, May 8, in the presence of several thousand people. The Garden was brilliantly illuminated, and presented a gala appearance. At 8:35 P. M. Senator Depew, escorted by President A. M. Young, of the National Electric Light Association; President C. O. Baker, Jr., of the Electrical Exhibition Company; General Manager Marcus Nathan, and Mr. Frank W. Hawley, chairman of the Inaugural and Reception Committee, and attended by a detachment of cadets from the Rugby Military Academy, reached the speaker's stand on the balcony on the Twenty-seventh Street side.

The following despatch from President McKinley was then read:

Executive Mansion, Washington, D. C.
May 8, 1899.

I am glad to have an opportunity to participate in the exercises incident to the opening of the annual electrical exposition this evening, and to congratulate those who are contributing to an increased knowledge in the field of electrical research and development. You have my best wishes for the success of the exposition.

WILLIAM MCKINLEY.

A telegram from Governor Roosevelt, received over direct Postal Telegraph wire at the Garden, was then read, as follows:

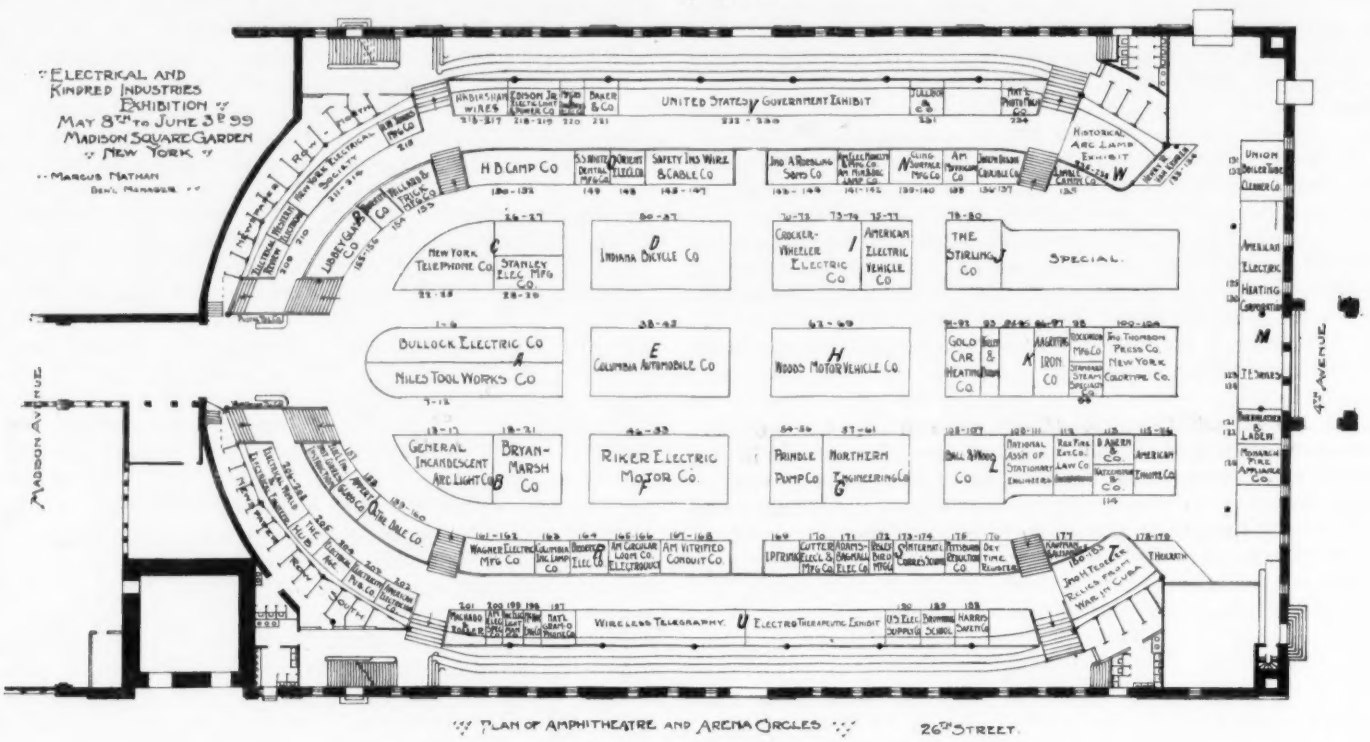
Congratulations on successful opening exhibition National Electric Light Association, marking centennial of Volta's great discovery of electric battery and another step in the application of electricity to man's safety, welfare and comfort.

THEODORE ROOSEVELT.

President Young, of the National Electric Light Association, then introduced Senator Depew in a few brief and happy remarks as the orator of the evening. Senator Depew made a felicitous speech which elicited frequent laughter and applause. He alluded to his continuous co-operation with the work of the association and the exhibition, and commented on the rapid growth with which from year to year he was brought in touch, down to the present evening, when he had been brought to the Garden in an automobile. Now and again they thought the limits were reached, but new developments constantly opened up, and the latest would be seen at this show. In fact, he said, "Everything that now takes pains and labor and leads to bad language when it does not go right, will be made perfect by the discoveries of electricity." He then alluded to the Röntgen ray, the Marconi wireless telegraphy, the registration of handwriting and portraits and events by fac-simile telegraphy, and the swift flashing of such news as the battle of Santiago, when the destruction of Cervera's fleet was known 10 minutes later in this country. He also referred to the use of the cable in transmitting news of Dewey's victory and in bringing together such countries as America and England. "We should thank God that we live in this marvelous age; thank God that we live when electricity is accomplishing these wonderful works; and pray that the electrical impulse may be applied to spiritual and to patriotic use; pray that electricity may help our government become greater and better, our country more the home of the free, and that electricity may enable each one of us to accomplish our part in life in a larger, nobler and broader way than we could if we lived a hundred years ago."

The oration was followed by the playing of the "Star Spangled Banner," and messages of thanks were sent to the President and the Governor for their participation in the exercises. The show was then declared open.

Among those present were Dr. Cyrus Edson, Dr. Henry E. Waite, Edward Weston, A. M. Young, C. O. Baker, Jr., George F. Porter, Commissioner Jacob Hess, Hon. R. P. Flower, C. W. Wright, M. L. Barnard, E. F. Peck, T. C. Martin, Herbert Laws Webb, C. A. Lieb, C. W. Price, Cooper Hewitt, F. W. Hawley, F. C. Mason, E. A. Leslie, E. A. Colby, J. D. Crimmins, James Kempster, H. L. Shippy, T. E. Crimmins, Robert Rutter, Chas. E. Simmons, Col. Ashley Cole, J. H. McGraw, W. D. Weaver, J. E. Woodbridge, Dr.



PLAN OF MADISON SQUARE GARDEN, SHOWING LOCATION OF EXHIBITS.

As usual a great many of the exhibits were not ready, but there were enough in shape to keep the large crowd amused all the evening. The fine exhibit by the War Department, Navy Department, Lighthouse Board, Smithsonian Institution and the Weather Bureau attracted much attention and general admiration. The same is true of the exhibit of wireless telegraphy, and of the exhibit of electricity under water in a big plate glass tank with a real woman diver assisted by experts. During the week a Bell radiophone will be set in operation with the aid of a General Electric searchlight and an 18-inch mirror. The local telephone company has equipped its exhibit with an interior exchange board connecting up some 40 leading exhibits with the outside world. In the concert hall an Edison moving picture exhibit has been put in constant operation. The Electrical Engineer Institute of Correspondence Instruction has a liquid forge in operation. In the basement a grotto about 100 feet long and 50 wide has been built, in the centre of which is a Cave of the Winds, where all the effect is obtained from static electricity on an ingenious spectacular plan devised by Dr. Cyrus Edson. Adjoining this is a

theatre with Bell theatrophone and a collection by Mr. J. Carl Mayrhofer of some 40 complete miniature theatrical scenes from plays, showing how they are lighted electrically, etc. At the other, south end of the grotto, are exhibits of the Röntgen ray and of high pressure effects. A special feature of great technical interest is the collection of historical arc lamps, got together by Messrs. E. W. Peck and C. W. Rice, who have devoted much time and trouble to the work.

A word of high praise must be given in passing to the general lighting effect devised by Mr. Luther Stieringer, who has been as original and successful as usual. He has treated the whole of the vast roof as a marquee and stretched an awning of light yellow and white, so that the roof proper is not seen, but only the spandrils, and these are picked out with hundreds of incandescent lamps. Depending from the marquee roof, midway to the floor, are rows of clusters of frosted incandescents, 16 lamps in each bunch. The starry effect and the equable diffusion of soft light is admirable. Last year's effects were beautiful, but this brilliant and harmonious scheme will not only surpass anything ever done before in the Garden, but be imitated.

On Saturday evening there will be special exercises in the Garden to celebrate the Volta centennial.

CURRENT NEWS AND NOTES.

CARBIDE PLANT.—The estimated output of the plant which is now being constructed at Niagara Falls is to be 100 tons of calcium carbide per day, using 25,000 electrical hp.

DEATH OF GUYER ZELLER.—Reports from Switzerland state that Mr. Guyer Zeller died on April 3. As is well known, he was the originator and chief promoter of the electric railway which is being built to the top of the Jungfrau, one of the high Alps. He formerly was the owner of a cotton mill, and later became interested in Swiss railroads. During the last few years he devoted himself chiefly to the Jungfrau Railway. It is to be hoped that his unfortunate death at the present time will not interfere with completing that grand and bold project.

CHICAGO TRACTION DEAL.—A despatch from Chicago states that representatives of the Elkins-Widener syndicate arrived in that city and have already undertaken the task of effecting the consolidation of all the street railway systems in Chicago. It is understood that one of the largest trust companies of New York will finance the enterprise. It is also said that the scheme involves the guarantee of 12 per cent. to the minority holders of North Side stock and of 6 per cent. to those possessing shares in the West Side companies. The roads will be operated under the charters now held by them.

ELECTRIC RAILWAY PREDICTIONS.—At the April meeting of the Chicago Electrical Association, Mr. W. D. Rae, of Detroit, read a paper on electric railways, in which he ventured a number of predictions as to the future. He held that the electric locomotive of the future would receive its power, not from an overhead or an underground trolley, but by inductive means from a conductor laid along the track, secondary currents being thereby induced in coils on the moving train. Mr. Rae believes that the application of electrical traction to trunk lines is not especially difficult and will have an early solution.

SUITS AGAINST THE WESTERN UNION TELEGRAPH COMPANY.—The Western Union Telegraph Company is being assailed all over Kansas with damage suits. They were begun in twelve counties at once, and in Topeka alone 200 were brought against the company, aggregating $25,000. These suits are the result of the alleged violation of the new law, which requires that the telegraph companies shall not charge more than 15 cents for a ten-word message within the state limits. Non-compliance with the provisions of the law subjects the company to a fine of from $100 to $500 in each case. The Western Union Telegraph Company threatens to close all the telegraph offices in Kansas as a retaliatory measure.

THE DIATTO ELECTRIC RAILWAY SYSTEM.—On April 22 the city of Tours, France, inaugurated its first railway line, which employs the Diatto system within the city and the trolley outside of the city limits. This is the first commercial application of the Diatto system, the principal feature of which is that only those rails are alive over which the car is passing. The system is extremely simple in its detail, no electromagnets being used. At intervals along the track are boxes partly filled with mercury, connections with the line terminating in the mercury. Each box contains a plunger dipping into the mercury, and free to move vertically. On the car is a magnetic bar, which makes contact with the top of the aforesaid boxes, thereby drawing the plunger into contact with the top and thus establishing connection between the car and the line. The contact bar is composed of a central and two outside bars, between which are mounted horizontal electromagnets, so disposed as to cause the middle bar to be of north polarity and the two outside bars to be of south polarity. A small battery of accumulators is contained in the car to prime the electromagnets in starting. The contact within the boxes is between carbons, one on the lid and another on the head of the plunger. The Diatto system is at present being installed at Lorient and at Reims, and one of the new Paris lines will also have this system.

THE SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION.—The following is a list of the papers to be read at the annual convention of the Southwestern Gas, Electric and Street Railway Association, which will be held at Austin, Texas, May 17-19: "The Item of Depreciation," by W. E. Hamilton, Shreveport, La.; "Meters," by W. E. Holmes, Austin, Texas; "Transformers," by H. L. Monroe, Dallas, Texas; "The Amount and Extent of Legitimate Investment in Electric Lighting Plants of Certain Capacities," by F. Fries, San Antonio, Texas; "Summer Amusements for Street Railway Companies," by T. H. Stuart, Waco, Texas; "Art and Science of Selling Gas," by T. D. Miller, Dallas, Texas; "A Model Plant Under Model Management; What Both Should be Like," by J. F. Strickland, Waxahachie, Texas; "Alternators," by E. Dysterud, Monterey, Mexico; "The Attitude of a Corporation to the Public," by W. H. Weiss, San Antonio, Texas; "Means for Encouraging the Diversified Use of Electric Current," by C. L. Wakefield, Dallas, Texas; "Mexican Paper 'Electric Lighting and Application of Electricity to Various Purposes in Mexico," by a Mexican delegate; "Arc Lamps," by Max Levy, Galveston, Texas. The headquarters of the association will be at the Driskill Hotel.

EXPORTS OF ELECTRICAL MATERIAL.—The following exports of electrical material, machinery, etc., were reported from the port of New York for the week ending this date: Antwerp, 31 cases electrical material $1038; Argentine Republic, 80 cases electrical material $1679; 23 packages electrical machinery $2187; Alexandria, 22 packages electrical machinery $7099; Amsterdam, 3 packages electrical material $150; British East Indies, 5 cases electrical material $183; Barcelona, 35 cases electrical material $714; British West Indies, 6 packages electrical material $124; British Australia, 16 packages electrical material $327; Bremen, 6 cases electrical material $156; Berlin, 14 cases electrical material $2572; Brazil, 14 packages electrical material $634; Brussels, 1 case electrical material $40; Chili, 87 cases electrical material $1200; Central America, 1 package electrical material $23; Copenhagen, 8 packages electrical material $109; Cuba, 35 cases electrical material $1253; Genoa, 1 case electros $1, 2 cases electrical material $23; Hamburg, 48 packages electrical material $3394, 5 cases electrical machinery $310; Helsingfors, 3 cases electros $66; Havre, 206 packages electrical machinery $19,817, 112 cases electrical machinery $2997, 11 cases electrical machinery $750; Hong Kong, 23 cases electrical material $300; Japan, 17 cases electrical material $2413; London, 170 cases electrical material $5766, 1 case electros $17; Liverpool, 24 cases electrical material $985; Mexico, 132 cases electrical material $914, 55 packages electrical machinery $14,150; Marseilles, 50 packages electrical machinery $425; Milan, 7 cases electrical material $384; Manchester, 11 cases electrical material $1760; New Zealand, 16 packages electrical material $426, 4 cases electrical machinery $442; Puerto Rico, 17 packages electrical material $541; Peru, 6 cases electrical material $248; Southampton, 38 packages electrical machinery $370; Siam, 9 cases electrical material $377; Stettin, 133 cases electrical machinery $28,867; U. S. Colombia, 3 cases electrical material $60; Venezuela, 57 cases electrical material $704; Zurich, 30 packages electrical material $1574.

ELECTRIC HEATING.—In a paper read before the French Sosiété des Ingenieurs Civils, M. Lalance said that to heat a room by electricity required an expenditure of 2.2 watts per cubic foot of space to maintain a difference of 40 degrees F. of temperature between the exterior and interior.

EFFECT OF ELECTRICITY ON DISEASES.—It is stated, in an article by good authority in an English journal, that electric welders are comparatively free from rheumatism. The writer admits, however, that he has not verified this. The point which he was referring to was that the light from the arc had a beneficial effect in a number of diseases.

CORPORATIONS IN PENNSYLVANIA.—A bill recently passed by the Pennsylvania legislature, and approved, provides a uniform tax for the incorporation of all companies, except building and loan associations. Heretofore steam and street railway, turnpike, bridge and cemetery companies have been exempt from the bonus on charters, but they will now be required to pay one-third of 1 per cent. on the authorized capital stock before they get their charters.

A NEW METHOD OF MOTOR CONTROL.—A patent was issued May 2 to Homer W. Corse, of Melrose, Mass., for a method of motor control, whereby the speed of a motor can be varied within wide limits. The invention is applicable to the ring type of armatures, and consists of an attachment to the armature on the side opposite the commutator end, of a series of contact points, one for each armature segment, the contact being circularly arranged; a contact brush within the armature cylinder formed by the contacts can be given a longitudinal movement, by means of successive sections of the armature coils may be cut in or out, thereby correspondingly affecting the speed of the motor.

PERMANENTLY ADJUSTED TELEPHONE.—A patent was issued on May 2 to Ernest Thielscher, of Brookline, Mass., on a means for permanently adjusting the pole piece of a telephone relatively to the diaphragm so that variation of temperature and moisture will not cause any displacement of the pole piece in relation to the diaphragm. The handle or cylindrical part of the telephone is separate from the cup part, the arrangement being such that the expansion of the handle part cannot affect the adjustment of the telephone. The cup, which is covered by the usual diaphragm held down by the ear piece, has secured to it at the bottom a shouldered pole piece for receiving the magnet spool; a key rigidly locks the shouldered pole piece to the cup and an extension on the back of the shoulder is clamped to the permanent magnet of the telephone.

A NEW COMMUTATOR BAR.—A patent was issued May 2 to Charles Frederick Brooker, of Ansonia, Conn., for a commutator bar having a surface of less electric conductivity than the body of the bar. In rolling the bar a hard coherent surface is produced upon it of less conductivity than the metal strip by allowing water or steam, or both, to flow continuously upon the heated strip during its passage through the rolls. By this treatment the moisture unites with the highly heated surface of the strip and chemically transforms the material of the surface into an oxide which is a poor conductor of electricity. In practice the inventor has found that this chemical action extends uniformly over the surface, so that the layer of copper oxide which is formed is entirely coherent and gives a hard, highly polished and non-conducting surface.

THE ENGLISH PACIFIC CABLE PROJECT.—It is reported from London that the committee appointed to consider the matter of the Pacific cable has recommended the route alread suggested and favors laying duplicate cables. The committee estimates a profit of £33,550 annually if 3s. 3d. per word is charged, and is of the opinion that the cable would pay in four years if 2s. a word were charged. The committee advises that the cables be worked by the governments interested, with a manager in London under the control of a small board. A despatch from Ottawa, Ont., states that information comes from London to the effect that the imperial government will only give a subsidy of not more than £20,000 to the Pacific cable and will not take shares in the enterprise.

WIRELESS TELEGRAPHY.—A writer in the New York *Herald* of May 7, who apparently has vague ideas as to the principles of the Marconi system, asserts that wireless telegraphy has been known for over 150 years. The evidence he offers refers to the humorously proposed electrical picnic of Franklin, and to various experiments in telegraphy by electromagnetic induction, including the well known ones of Henry, Morse and Dolbear. The first mentioned in 1838 by means of discharges of coils, transmitted signals through the air a distance of 18 feet. Early in the forties Morse by electromagnetic means transmitted signals through the air between Governors Island and Castle Garden, and across the Potomac at Washington. Prof. Dolbear about 1882 elevated wires in the air several hundred feet, and at one station heard through a telephone messages from a telegraph apparatus at the other.

A NEW STORAGE BATTERY.—A patent was granted May 2 to Augustus J. Marquand, of Cardiff, England, for a new type of storage battery plate and method of forming the same. The plate consists of a grid, a number of variations of which are shown, having for strength one or more solid webs of metallic lead and with conducting bars on the top and across the centre. Those parts of the ribs and parts of the plate that are not to be acted upon are coated with a fusible enamel in a state of powder mixed with a suitable medium, which is then heated by a blowpipe of oxy-hydrogen flame, with the result that the enamel is fused without melting the metallic lead underenath. The enamel for this purpose consists of calcium chloride, feldspar, sodium silicate, silicon dioxide and barium sulphate. The plate so protected is then placed in a metal box and covered with sulphur, the amount of the latter being about 2 grams for each ampere-hour of required capacity of the plate. The box containing the plate is then placed in a furnace and heated to the melting point of lead. By this means portions of the lead of the plate are converted into sulphide of lead, the construction of the plate being such, however, that there is a continuous network of conducting backing of metallic lead unacted upon by the sulphur, while the protecting parts of the plate are also unacted upon. The plate so prepared after being allowed to cool, is removed from the box, placed in a bath of sulphuric acid, and the sulphide of lead reduced by current to a state of metallic lead in a highly porous form. By reversing the direction of the current through the electrolytic cell, the plate may be peroxidized to form the negative of the battery. The plates thus produced may be used flat, or after having been reduced to a metallic state, may be folded or bent to any required form before being peroxidized.

A NEW ELECTROLYTIC ALKALI PROCESS.—A company is being formed for the working in this country of the Hermite-Dubosc-Rhodin patents for the electrolytic production of caustic soda and bleaching powder. In a report by the late Dr. John Hopkinson the main advantages of this system are stated to be that a large current can be passed through a small apparatus, and that the electrolyte and resulting caustic alkali are heated, which results in apparatus not only compact for a given output, but leading to the reduction of losses due to secondary action on account of the dense current employed. Another advantage noted is the low electromotive force necessary. The apparatus consists of an iron containing vessel which is partly filled with mercury; inside this vessel there is inverted another of eatherware, which in operation is kept revolving about its axis, the axis being concentric with that of the outer vessel. Hermetically sealed in the second vessel by means of cement are carbon electrodes which dip into brine placed on the top of the mercury. A central opening in the movable vessel carries off the chlorine gas liberated, which gas is utilized in the manufacture of bleaching powder. The brine for reduction is also sent through this tube. It will thus be seen the brine is enclosed on the surface of the mercury, that current is conveyed to it by means of carbon electrodes, and that the mercury and outer iron case form the other electrode. The chlorine is given off at the surface of the carbon poles and, as above mentioned, passes away to bleaching chambers. The sodium amalgam forms on the surface of the mercury, which is also the bottom surface of the brine, and passes partly by diffusion and partly by the mechanical agitation of the mercury occasioned by the revolution of the inner vessel, to the outer annular space between the latter and the sides of the iron vessel, where a layer of water extracts the sodium in the form of caustic soda. In actual working the iron containing vessel is heated externally to a temperature very near to the boiling point, which not only prevents the absorption of a large amount of chlorine in the brine, but also increases the efficiency of water in taking out the caustic from the amalgam, and reduces the electrical resistance.

MORSE IN PUERTO RICO.—In the New York *Herald* of May 7 it is reported that Colonel Glassford, U. S. A., Chief Signal Officer in Puerto Rico, has discovered in Arroyo some crude telegraph instruments with which "in the thirties" Morse there made his initial experiments in telegraphy. A love tale, a horse speeding faster than the first message, the consequent despair of the invntor, another trial six months later in which the message out-raced the horse—these form incidents of the story told. The reporter notes with surprise that none of Morse's biographers refer to the Arroyo incident in their account of the life of the inventor Were it true, it may be added, Morse could not have failed to leave on record the fullest details of the alleged experiments.

ELECTRIC METERS.—Two patents were issued on May 2 to Roger S. White, of New York City, one on an electric meter and another on means for reducing friction in rotating shafts of electric meters. The coils of the electric meter rest on a circular disk of mica, and over the coils is placed a flat annular ring of non-magnetic metal, which ring moving through a magnetic field serves to retard the speed of the armature. The armature field, which is also the retarding field, is produced by permanent magnets having on them a coil in shunt with the main meter circuit, by means of which a more intense magnetic field is produced than is possible with a simple permanent magnet. The disk is mounted on a horizontal axis of magnetic material, and in proximity to the latter are the poles of a magnet, the attraction between which and the axle serves to lighten the load on the axle bearings and thereby reduces the amount of friction.

THE ELECTRIC LIGHT ASSOCIATION CONVENTION.—The Trunk Line Association, the Central Passenger Association, the Southeastern Passenger Association and the New England Passenger Association have granted a rate of a fare and a third, on the certificate plan, from points in their territory and return, for delegates and friends attending the twenty-second convention of the National Electric Light Association, to be held in New York, May 23, 24, 25. The following named gentlemen will have charge of transportation matters for their several localities: Mr. W. Forman Collins, 510 Marquette Building, Chicago, Ill.; Mr. H. A. Wagner, Missouri-Edison Company, St. Louis, Mo.; Mr. C. F. Hesser, Cincinnati Gas Light and Coke Company, Cincinnati, O.; Mr. Morris W. Mead, city electrician, Pittsburg, Pa.; Mr. R. F. Ross, 620 Atlantic Avenue, Boston, Mass.; Mr. H. B. Cutter, 1112 Sansom Street, Philadelphia, Pa.; Mr. S. C. D. Johns, Cleveland Electric Illuminating Company, Cleveland, Ohio.; Mr. M. L. Stern, city electrician, Denver, Colo.; Mr. H. M. Atkinson, Georgia Electric Light Company, Atlanta, Ga., and Mr. E. R. Weeks, Kansas City Electric Light Company, Kansas City, Mo.

SHIP'S TELEGRAPH.—A patent was granted April 25 to Leon S. Thompson, Washington, D. C., for a ship's telegraph for transmitting signals, orders, etc. The inventor states that he has had more especially in view the provision of an electric telegraph adapted to the special conditions that exist aboard ship, and which will be free from the defects which have caused the failure of similar appliances heretofore used. Each piece of apparatus combines a transmitter and receiver, the latter anabling a message to be repeated back, as in the case of mechanical telegraphs. The principle consists in the employment of a series of solenoids embracing a circular movable core carrying an index, the position of the latter in the core being changed by the energizing of the different solenoids of the series. On the transmitter is a series of fixed contacts, each of which is connected with a section of the solenoid, and in combination with a traveling contact directly connected with all the solenoids. In order that the transmitter handle may not be given a movement so rapid that a solenoid can be cut out of circuit before it has acted on the core, a retarding device is employed, consisting of a cylinder filled with oil and having a perforated piston.

FREIGHT CLASSIFICATION OF ELECTRICAL MERCHANDISE.—The committee of the National Electric Light Association appointed to effect some readjustment in the freight classification on electrical merchandise, has received from the Official Classification Committee of the railroad companies, a reply to the effect that the committee, after careful deliberation, does not deem it expedient to recommend any change in the classification of this class of property. It is the desire of the committee of the National Electric Light Association that all manufacturers and others interested in tariff changes have some one present at the convention to be held at Madison Square Garden, New York City, May 23-25, who will meet with the committee with the idea of taking some vigorous action calculated to bring about a just and equitable tariff. An announcement will be made on the opening day of the convention of the time and place of a special meeting of this committee. Every central station in any large city, or any considerable user of electrical apparatus, as well as every electrical manufacturer of heavy machinery and electric lamps, should be sufficiently interested in this subject to have some one in attendance at the convention to advise with the committee in carrying out the object for which it was created.

THE RAPID TRANSIT TUNNEL BILL PASSED.—The New York rapid transit bill, in which were incorporated amendments suggested by Gov. Roosevelt against the granting of a franchise in perpetuity and providing for free competitive bidding, passed both houses of the New York Legislature on April 26. The amendments provide two methods of building a rapid transit road, the first by the city and tne second by a railroad corporation already organized or hereafter organized if the Rapid Transit Commission decides that the construction of the road by the city is impracticable. If the commission adopts the second method of construction it must hold at least two public meetings prior to July 1, 1899, for the purpose of receiving suggestions as to the plans for the road. Beginning on Oct. 2 the commission is to advertise for four consecutive weeks in five daily newspapers at least three times a week, for sealed proposals for the construction, equipment, operation and maintenance of the railway. The proposals shall be sumbitted on or before Jan. 2, 1900, at noon, at which time they shall be opened. The grant is to be for a term not to exceed fifty years and shall provide for a readjustment of terms upon which it may be renewed for periods not to exceed twenty-five years each. The determination of the terms or renewals is to be made by arbitration or by the Supreme Court. The grant shall also provide for a valuation of the property of the grantee in connection with the road and for the purchase of this property at such valuation by the city at its option at the expiration of each period of readjustment. If the city shall elect to purchase the property it may at its option issue gold bonds bearing not less than 3 per cent. interest to the amount of the valuation of the property and such bonds shall be accepted by the grantee at their par value. Any such valuation shall include all of the valuation of the property rights of the grantee in all galleries, pipes, subways or conduits, controlled or used by it., The Rapid Transit Commission shall have free access to the books and records of the grantee for the purpose of determining the original cost of the road, the amount of the gross receipts and the expense of operation.

LETTERS TO THE EDITOR.

Sine Wave Telegraphy.

To the Editors of Electrical World and Electrical Engineer:

Sirs.—My attention has been called to a report in your issue of April 29, in which it is stated that by the sine-wave system 3000 words per minuate were transmitted over a cable from New York to Canso, N. S. As is well known, 50 words per minute is great speed over the best Atlantic cables, and confusion has arisen between land speeds and cable speeds.

GEORGE O. SQUIER.

WASHINGTON, D. C.

Insulation Resistance.

To the Editors of Electrical World and Electrical Engineer:

Sirs—It has been my fortune to come in contact with a great many contractors and engineers who are frequently measuring insulation resistances, and the methods of many of them are such that I cannot refrain from a word of criticism. The method to which I particularly refer is that of measuring the resistance with a battery of a few cells (five or six at the most), and an ordinary Wheatstone bridge. This arrangement is entirely unfitted for the measurement of insulation resistance.

So long as the insulation resistance is less than two or 300,000 ohms, the readings may perhaps prove accurate within 10 per cent.,

but when the resistance rises to 2 or 3 megohms, the method appears to me to be very fallacious. In the first place the experimenter is shunting his insulation resistance with another resistance of perhaps about the same magnitude, namely, the insulation between the binding posts of his instrument. This is evident because the readings can be varied as much as 90 per cent. by simply breathing upon the Wheatstone bridge. It is therefore evident that conditions of moisture surrounding the instrument will throw such an error into the readings that it is of no more value than an abstract guess.

Further than this, insulation resistances are very peculiar. They change enormously with temperature and the measurements of one day or even one hour may vary 25 or 30 per cent. from that of a succeeding period. Insulation resistances also possess the peculiar property of varying with the electrical pressure impressed upon them. An insulation resistance may measure 5 megohms with a few cells of battery. With 50 cells of battery it may measure 500,000 ohms. With 220 volts pressure it may drop to 100,000 ohms and with 500 volts pressure a short circuit might ensue. That these are pertinent possibilities actual experiment has shown. It seems to me therefore that the popular demand for small portable sets of enormous range extending to 4 or 5 megohms is an absurdity, for such an instrument used for high resistance measurement is simply a device to enable the experimenter to make a very poor guess. Even if the proper coils are provided for the purpose, nothing short of a reflecting galvanometer which is anything but portable, would suffice to indicate a close condition of balance.

The money expended for a high range testing set would be very much more wisely spent in procuring an instrument with a maximum measuring capacity of 200,000 ohms and of greater accuracy, more careful workmanship and closer readings on the lower resistances. The measuring of insulation resistance should be left to suitable apparatus such as a voltmeter and a source of electro motive force equal, at least, to that the insulation resistance is to withstand, and preferably one several times greater.

GEORGE T. HANCHETT.

NEW YORK, N. Y.

Electrolysis.

To the Editors of Electrical World and Electrical Engineer:

Sirs—In the issue of April 29, under the Digest head, "Electrochemistry and Batteries," the following sentences occur: Chemical Energy in Cells. "* * * Moreover, two batteries of a certain kind will not decompose water when it is acidulated with sulphuric acid, but will do so if acidulated with hydrochloric acid. He shows that it is the compound which absorbs the least heat which tends to be decomposed in preference by the voltaic current, * * *."

In the first sentence water is mentioned as the substance undergoing decomposition, and in the second, it is the acid. Here are two contradictory statements—that black is white, and white is green.

On account of the extremely low conductivity of pure water, it has never been electrolyzed, though the extent of its dissociation into $+H$ and $-OH$ ions has been calculated. The apparent electrolysis of water is due to the electrolysis of soluble impurities and the liberation of oxygen and hydrogen through secondary reactions between the decomposed impurities and water at the electrodes. When sulphuric acid in water is electrolyzed, $H_2SO_4 = H_2 + (SO_4)$, the $+H$ ion is liberated at the kathode as molecular hydrogen H_2; the $=SO_4$ ion migrates to the anode, where it reacts on the water (in a state of dissociation— $+H$ and $-oH$), liberating an atom of oxygen and reforming an electrically neutral molecule of H_2SO_4.

In the electrolysis of hydrochloric acid no secondary reactions occur, and molecular hydrogen and chlorin appear at the electrodes— $2HCl = H_2 + Cl_2$.

In the face of these facts, I cannot understand why various writers persistently speak of the electrolysis of water. If the acid is used simply to make the water a conductor, then why should oxygen and hydrogen appear at the electrodes when sulphuric acid is used, and chlorin and hydrogen when hydrochloric acid is used.

HARRIS GOLDSTEIN.

NEW YORK, N. Y.

[As the clause which our correspondent refers to is practically a literal quotation from the original, his criticism applies to the original and not to our abstract. Mr. Tommasi in the original refers several times to the "decomposition of water," but in one case in which the water is acidulated with hydrobromic acid, he remarks that it is not the water which decomposes but the hydrobromic acid itself, the latter requiring only 59 calories to decompose it while water requires 69.

We agree with our correspondent in that it is not always correct to speak of the electrolysis of the water when it is really the acid or salt in solution which is electrolyzed. We do not agree, however, that it is an absolutely settled question in all cases, as to which is the primary and which the secondary action in such an electrolysis. According to the article of Mr. Tommasi, it is the compound which represents the least heat of combination which tends to be decomposed in preference by the current, provided this reaction can be commenced. If this is true, may it not be that the acid sometimes fulfills this last requirement, of starting the reaction?—Eds.]

Electric Railway Return Feeders.

To the Editors of Electrical World and Electrical Engineer:

Sirs.—I have read with interest the editorial in THE ELECTRICAL WORLD AND ENGINEER in your issue of April 15, in regard to the return feeders for electric railway systems. The attitude of your journals has always been one of equity and candor, and I cannot but believe that the opinions expressed regarding electrolysis should be modified when the technical facts bearing on another view of the question are presented. A brief history of this question of electrolysis may be interesting, as fas as the railway interest is concerned.

In 1887 attention was first brought to this matter of destruction of subterranean conductor systems paralleling railways with the ground return formed by the rails, and casualty predictors foresaw frightful destruction of water-piping systems. Their prophecies did not immediately mature, but in 1891 another wave of terror passed over the country, during which frequent pictures were drawn of the havoc which would arise from these ground return currents, and in the present day we have another popular outcry against street railway systems. In several cases the water companies have had the dangers so magnified to them by rail-bond manufacturers and promoters of electrolysis panaceas, that they have been forced into taking a ground which has been in no wise warranted by the facts of the case.

The lead sheathing of underground cables has been protected for years by the very simple method of connecting the cable at properly determinable points to a ground return feeder leading back the negative bus, in order that the current seeping into this cable covering should be carried away from it by a metallic connection instead of passing off in an electrolyte which will decompose the surface from which the current leaves.

The remedy of which you make mention, is referred to as a simple means for greatly reducing this alleged wholesale destruction of property. I cannot agree with this, because in my practical experience with a great number of railway systems, I have not been able to find a simple means nor panacea. Every system is a problem in itself with respect to the deflection of current from the underlying water pipe system to the ground return rail, and it has been my pleasure to go over 1200 miles of railroad in the last four years, locating and determining these matters of destruction by electrolysis. Summing the whole thing up, I have not been able to find more than 800 feet of lead surface pipe and 300 feet of water mains and 140 feet of gas mains which have been so deteriorated by electrolysis as to render their further service doubtful. Eighty-two per cent. of this damage occurred in three systems.

It may be pertinent to remark right here that the worst cases of electrolysis I have met with, and the one where the management was the least inclined to take preventive measures, was in a case where the water company's property and railway property were owned by the same persons. Street railway managers are not at all ignorant regarding this destruction by electrolysis, and a great deal of money has been spent in this country to improve the ground return, and frequent inspection of bonding is being carried out on a number of systems. Railway managers must be admitted to be men of business acumen, and it is well known that they surround every condition of their business by safeguards to reduce the hazards of passengers and machinery in order that the revenue on the capital employed may not be diverted. Is it not reasonable therefore

to assume that they will extend this principle to the protection of adjacent property?

The delivery of the proper potential to an equipment is necessary in order that it should maintain its schedule and reduce depreciation and the cost of energy required per car mile. The results secured from investment in the ground return feeder show an abundant return without the consideration of electrolysis at all.

In regard to the statement concerning customary practice, I will say that of the forty-three railroad systems with whose return conductor system I am perfectly familiar, I only know of one which provides connection between the rail and the power station at one point only. The rest of them are all using ground return feeders on the pole lines and tapped to the rails at determinable points for the purpose of reducing the ground-return drop.

The uni-potential rail method suggested will prevent the use of the rails as a main by the return current, but only when the system is equally loaded In the case of congestion of traffic or a blockade, the feeder possessing less than the average drop will tend to shunt the current of the water pipe system from those feeders having a maximum drop In other words, the proposed remedy in such a case will still require the use of the rails as a main, the only difference being that instead of working with the drop of potential of 15 to 18 volts, which is the generally allowable limit for ground returns, the condition will be aggravated by increasing the drop, bringing up the loss of potential on the ground return. The cost of the loss by this method at three cents a kw hour, applied to the problem cited, would pay interest on an investment of $27,000 without considering the extra depreciation of electrical equipment due to the low pressure delivered. This sum, if expended in more copper adjacent to the station would be much more efficacious in reducing the total voltage loss, and the tendency to electrolysis.

Again, the abandonment of the use of the rails as a main for the return current, with uniform loading, as is assumed, would mean a serious loss, as it would be equivalent to giving up as a conductor (for a double track road laid with 90-lb. rails) of 633,600 lbs. of steel. To replace this with copper of the same carrying capacity (taking the ratio 12:1) would cost about $10,000 per mile.

There are certain cases where sufficient attention has not been given by the managers to this question of local electrolysis, but to condemn the whole railway interest for the shortcomings of a very few is hardly fair in this case.

ALBERT B. HERRICK.

NEW YORK, N. Y.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Direct Current Dynamo Without Brushes.—A curious form of generator in which the commutation of an alternating into a direct current is produced without any sliding contact, is described by Mr. Campbell in the Lond. *Elec. Rev.*, April 14. Although the method is probably of no use for the generation of currents on account of the low efficiency, it is nevertheless of interest and may prove of use for the measurement of certain alternating current quantities; it is also an instructive lecture-room experiment. Suppose a bridge to have four arms of equal non-conductive resistance and a battery as usual, two of the arms connected to one terminal of the battery being made of bismuth; if a strong magnetic field alternately cuts the two bismuth arms, their resistances will be largely increased and the bridge will be thrown out of balance, thus producing an alternating voltage at the two corners of the square not connected to the battery. From this he passes to the converse case in which a source of alternating e. m. f. gives a uni-directional current. Referring to the first of the

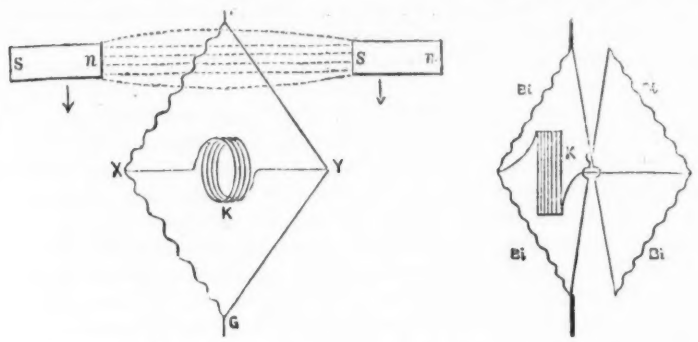


ILLUSTRATION OF PRINCIPLE OF NEW FORM OF GENERATOR.

adjoining figures the battery of the bridge is replaced by a coil whose plane is perpendicular to the paper; the two wavy lines are the bismuth resistances. A magnetic field as shown is caused to move downwards and is followed at distances equal to *F G*, by a series of similar fluxes; an alternating current will then be set up in the coil *K*, but owing to the action of the bismuth arms a uni-directional difference of potential will be produced between *F* and *G*, from which a rectified current may be taken. For obtaining a uniform continuous current a sufficient number of such elements are connected in series, the bismuth arms forming a circle which is under the influence of the rotating unipolar field. For more efficient commutation all four of the arms should be of bismuth as shown in the second figure, the relative positions of two of them being reversed as shown. He finds that in the most favorable case the rectified voltage would be less than one-quarter of the alternating voltage induced in the coil. The apparatus would work much better at very low temperatures. He shows how the same property of bismuth may in a similar way be used for rectifying an alternating current without the use of moving circuits. In this apparatus a strong permanent magnet is placed with one pole opposite and close to that of an electromagnet excited by the alternating current; a bismuth strip is placed between these and is shunted with a low resistance choking coil and a moving coil galvanometer. If the permanent magnet is strong enough, the magnetic flux through the bismuth never changes sign and the strip will have a higher resistance for one-half of the alternating current than for the other, thus producing a practically rectified current in the galvanometer circuit. The continuous current obtained is exactly equal to the mean squares of the original pulsating circuit, although the values of the mean squares will be very different. Instead of bismuth, copper wires may be used whose resistances are varied by a moving gas flame.—Campbell. Lond. *Elec. Rev.*, April 14.

Unipolar Machine.—A brief illustrated description of an unsuccessful attempt to design a homopolar dynamo in which the fallacy was the same as that in many other similar unsuccessful machines, namely, that it was supposed that the induction in a return copper wire could be shielded or prevented by enclosing it in iron.—Turnbull. Lond. *Elec. Rev.* April 21.

REFERENCES.

Compounding Alternators.—A long translation in abstract with a number of illustrations of the article noticed in the Digest Feb. 4.—Danielson. *L'Eclairage Elec.*, April 15.

Alternating Current Motor with Large Starting Torque.—A long abstract with illustrations of the article noticed in the Digest March 25 (see also April 22).—Deri. *L'Elec.*, April 15.

Transformers.—Illustrated descriptions of improvements taken apparently from patent specifications.—Guildbert. *L'Eclairage Elec.*, April 15.

LIGHTS AND LIGHTING.

Alternating Current Arc.—The long abstract of Messrs. Duddell and Marchant's paper (see Digest last week), is continued in Lond. *Elec.*, April 21. They describe experiments made with search or test carbons placed in the arc in order to investigate the fall of potential in the arc and at the carbon. They found that the drop at the positive crater was always much larger than at the negative. In spite of the difficulties encountered they think their results show conclusively that at any instant the distribution of the difference of voltage in the alternating arc is similar to that in the direct current arc; also that the growth of the front peak in the voltage curve of the long solid arc and the movement of the dent in that curve of the solid arc (meaning an arc between solid carbons) tends slightly column during such extinction as the arc is lengthened. They then discuss the effect of resistances in series; they carried out a com-

plete investigation for several different lengths of arc and made an immense number of experiments; some of the curves are reproduced. They found that an increase of the resistance in series with the solid arc (meaning an arc between solid carbons) tends silghtly to increase the peaks on the voltage curve of the arc, the effect being most marked on the 1-mm arc. The effect on the current wave was in all cases to make it more like the circuit wave from the alternator which was used. The power factors with the Ferranti alternator all tend to increase with the increase of resistance in series, while those with the Pyke and Harris machine decrease for the solid and the solid-cored arcs and are almost unaffected by the cored arcs. Their results confirm the conclusions of Firth that the efficiency of the alternating arc is affected by the amount of resistance in series with it. Firth's remark, however, that the arc has the power of automatically converting any wave form into the one best suited for its requirements, is not borne out by their experiments. The effect of frequency was then investigated between the range of 29.2 and 200 per second, the current being always brought back to a fixed root-mean-square value. The effect of reducing the frequency is in all cases not only to increase the actual time during which the current remains small in each period, but also to increase the fraction of the period during which it is so. Accompanying this is a considerable increase of the maximum value of the current with the decrease of frequency, and this causes the low frequency solid arc to hiss so badly that they were unable to obtain results below a frequency of 57; the solid-cored arc was slightly unstable at 46 and the cored arc at 29.2 when, however, the light was exceedingly unpleasant. With the current and other conditions kept constant, a lowering of the frequency increases the root-mean-square values of the voltage for the solid arc, but reduces it for the cored arc and has apparently no effect on the solid-cored arc. The power factor in all cases which they tried was reduced by lowering the frequency. As far as the light efficiency is concerned a reduction of the frequency is very advantageous, but there is a practical limit to the instability of the arc. Arcs on transformers are next discussed. They found that the characteristic forms of the current are transmitted through the transformer; but that with the constant current transformer the distortion of the potential wave is not transmitted on account of the greater magnetic leakage. Arcs between different commercial carbons are then discussed. They found that the characteristic reactions of the arcs on the wave forms are seen to occur in all cases, although they are modified in amount by the nature of the carbon and the presence of impurities. They also made experiments with arcs between one solid carbon and a cored carbon with a foreign substance in the core, hoping to discover some substance which does not impair the luminous efficiency but would reduce the reaction on the wave forms, in which, however, they were unsuccessful. They found, however, that it was possible to considerably reduce the voltage necessary to maintain an arc of given length and current without affecting its appearance, by treating the carbons with a potassium salt, and it seems more than probable that the low voltage and steady burning qualities of the cored arcs are due in a large measure to the presence of potassium silicate in the core. With foreign substances not in a metallic state nor reduced to it, there is a reduction of the voltage between the carbon for a given weight and current, and there is generally a reduction in the reaction on the wave form and an increase of the power factor.—Duddell and Marchant. Lond. *Elec.*, April 21.

A brief abstract of the paper is published in the Lond. *Elec. Rev.*, April 21.

Unsymmetric Alternating Arcs.—Some time ago Sahulka and Lang showed that an alternating arc between iron or aluminum as one pole and carbon as the other, appeared to be the seat of a continuous current flowing from the metal to the carbon. Prof. Blondel in a recent Academy paper, reprinted with the illustrations in *L'Elec.* April 22, investigated these unsymmetric arcs more completely, with the aid of his oscillograph, by means of which he obtained the curves of the waves; these are reproduced in 15 diagrams, and they give the wave of the current and that of the voltage in a number of different cases; in most of them copper was used, while in others the metal was aluminum or iron. He states that all the metals used, with carbon as the other pole, gave rise to the same phenomena, the results differing only quantitatively; a core in the carbon containing silicon made the observations easier, as the conditions were not suitable, especially with long arcs; copper gave the best results. He divides the results into two classes, the short arc and the long arc, and discusses each briefly. With a non-inductive circuit he finds that the current is established in the direction of the metal to the carbon when the arc is first started; it then stops and remains interrupted during a half-period, during which time there is, may be, a slight current, due no doubt to a conduction by the hot gases; in most cases, however, this small current disappears entirely. He claims that it is not correct to state that such an arc is the seat of a continuous current.—Blondel. *L'Elec.*, April 22.

Life and Economy of 220-Volt Lamps.—Mr. Bragstad, in the *Elek. Anz.*, April 23, replies to some criticisms of his recent tests and deductions, which were noticed in the Digest April 8 and 15. His tests were somewhat unfavorable for the 220-volt lamps; he claims that these lamps cannot be considered as competitors until their efficiency has been increased from 2.5 to 2 watts. The reply is answered by the critic, Mr. Gruenwald, who claims that while the present 220-volt lamp is capable of being improved, yet he believes it to be good enough at present to warrant the construction of 220-volt stations, all the more so as a new lamp will soon be put on the market, and because it is expensive to change a plant in the future from a low to a higher voltage.—*Elek. Anz.*, April 23.

POWER.

REFERENCES.

520-kw Gas Engine.—A brief illustrated description of a 520-kw direct-connected Westinghouse gas engine and dynamo.—*Eng. News,* May 4.

Large Engine.—A brief illustrated description of the first one of the 1000-hp compound engines for the Liverpool railways.—Lond. *Elec.* and *Elec. Eng.*, April 21.

TRACTION.

Resistances for Starting Railway Motors.—In a long article in the *Elek. Zeit.*, April 20, Mr. Erens describes an analytical and a graphical method for calculating the proper starting and braking resistances for railway motors. Formerly these were determined empirically and it was incorrectly concluded that the steps in the resistance which were determined for one case would apply to another; by his method they may be calculated correctly in advance. Although apparently not so stated, he seems to limit himself to the resistance method of starting as distinguished from the series parallel method. For the most uniform starting the acceleration should be as uniform as possible; a maximum and a minimum current must therefore be decided upon before resistances can be calculated. This maximum depends on the current which the motor can stand, also on the skidding of the wheels and the fact that the car must not be started with a jerk. The mean current depends on the time in which the train must reach its normal speed. The minimum should be made as high as practicable; it becomes determined if the number of stops is fixed. His formulas are deduced for both the series and the shunt motors. He shows that if the starting should be as uniform as possible or if the current should vary only between two fixed limits, then the increase of the speed due to each step in the resistance must diminish in geometric progression the exponent of which is the ratio of the minimum to the maximum current multiplied by the ratio of the magnetisms in each of the two cases; by the latter quantity he means the product of the number of active wires and the number of lines of force per pole. Moreover, the resistances which must be cut out at each step must also decrease in the same geometric progression with the same exponent. Similar deductions are made for the resistances used for electric braking. He shows in electric braking, if the current is to vary between two fixed limits, the resistance must diminish proportionally with the velocity. The resistances should diminish in the same geometric progression stated above.—Erens. *Elek. Zeit.*, April 20.

Electric Elevator.—A full description with a double-page insert of the elevator in the Park Row Building.—*Eng. News,* April 27.

The same issue also compares editorially the electric and the hydraulic passenger elevators for high buildings. The electric screw elevator is at least as safe as its rival; it has more operating parts and much more complicated machinery which is more liable to injury by fire and water and minor breakages; it will certainly cost no more to operate than the hydraulic, and if a properly proportioned storage battery is installed a material saving can be safely counted upon. The compactness of the electrical elevator is admitted even by the advocates of the hydraulic system; the question of first cost is a disputed one, but the belief is expressed that the costs of the two systems do not differ greatly.—*Eng. News,* April 27.

Speed of Automobiles.—According to Lavergne, the record for speed is held by the Jeantaud electric vehicle, which ran a kilometer in 38 4-5 seconds. That for a petroleum motorcycle in 57 3-5 sec-

onds and for a petroleum carriage 1 minute 3 seconds.—*Rev. Gen. des Sciences,* April 15.

REFERENCES.

Electric Power for the Glasgow Railways.—A long abstract of a report to the Tramway Committee of that city on the generating and distributing of electric power for the Glasgow municipal tramways. It also contains a statement of current electric practice which is of general interest.—Parshall. *Eng. News.,* May 4.

Detroit.—An article on the municipal ownership in that city. When the courts have acknowledged the right of the city to try municipal ownership, then that city will have acquired the control of all street car properties on a basis entirely satisfactory to the owners.—*St. R'y Rev.,* April 15.

Municipalities and Street Railways.—An article on their relations from the standpoint of the owner of the railway.—Boyle. *St. R'y Rev.,* April 15.

Operating Expenses of Connecticut Roads.—Brief operating statistics for each of a large number of roads for 1898.—*St. R'y Rev.,* April 15.

Electric Railways in Vienna.—A list of the 69 lines which are to be equipped electrically.—*Elec. Tech.,* April 15.

Electrolysis from Railway Currents.—An article written in a popular style.—*Jour. of El'ty,* March.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Unequal Loading in Polyphase Distribution.—Mr. Spagnuolo, in the *Nuovo Cimento,* 7, p. 293, a brief abstract of which is published in *Science Abstracts,* February, discusses the variations in pressure produced in three-phase distribution when the loads on the three circuits are unequal with respect to resistance, self-induction or capacity. He considers only the star system and treats it theoretically at great length, giving also the results of some experiments, arriving at the following conclusions. If 1, 2 and 3 be the three circuits in the sense of the rotating field, and *a, b* and *c* the respective voltages, then if the resistance in 2 is increased, *b* is the largest, *a* smallest and *c* slightly more than *a*. The same effects are produced in the difference of potential between each conductor and the neutral wire, but the variations are less marked. With equal resistances, if a self-induction is introduced in 2 then *b* is largest, *c* smallest and *a* slightly more than *c*. With the pressures compared with the neutral wire, *c* is smallest and *a* and *b* equal.—Spagnuolo. *Nuovo Cimento,* 7, p. 293.

REFERENCES.

Hammersmith.—An illustrated description of the recent extensions in this alternating current plant. One of the interesting features is that rectifiers are used for street arc lighting and that as they have been successful their number has been increased; these rectifiers have been so satisfactory that the makers are now standardizing them. For street lighting the current is rectified at 3200 volts.—Lond. *Elec. Rev.,* April 21.

Typical California Lighting Plant.—A brief description of the Monterey and Pacific Grove lighting plant, which is said to be of the type most common throughout California. It contains direct-current machines for nearby lighting and an alternator for distant lighting.—Bean. *Jour. of El'ty,* March.

Bootle.—The beginning of a well illustrated description of the central station in that town in which the three-wire direct-current system is used with 220 volts on each side.—Lond. *Elec. Eng.,* April 21.

Paris.—A small table of operating statistics of the six stations in Paris.—*Elek Zeit.,* April 20.

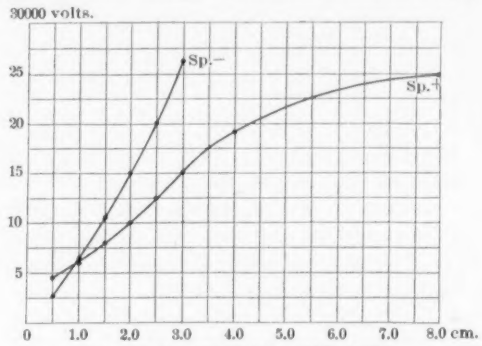
WIRES, WIRING AND CONDUITS.

Mechanical Strains in Long Spans.—In an article of a mathematical nature by Prof. Juellig, in the *Zeit. fuer Elek.,* April 23, he deduces formulas and discusses various features concerning the mechanical strength and sag of long spans of overhead wire. In practice it is generally sufficient to assume that the curve of a span is parabola, but when the spans are very great the error involved in doing this cannot be neglected. He deduces formulas based on the true catenary curve, and gives some data in tables and curves to facilitate calculations. In conclusion he makes some interesting deductions. He shows that the maximum span is independent of the cross-section of the wire; but this is true only when the strains due to snow, ice and wind are not considered. A table gives the maximum possible spans for different materials assuming a factor of safety of four; for cast steel this maximum span is 5.87-km; for silicon bronze 2.59 and 1.68; wrought iron 1.70, and soft copper 0.89. It is therefore possible to run a single span of steel wire between 5 and 6-km in length (3 to 3.5 miles), but in that case there would be a sag of 2-km; the factor of safety would be three to four fold.—Juellig. *Zeit. fuer Elek.,* April 23.

High-Tension Cable.—Tabular results of tests are given by Dr. Koepsel in the *Elek. Zeit,,* April 20, of a Siemens & Halske, cable for three-phase currents of 8000 volts which has been in use for a year. The length of the cable was 450 meters; it is coverel with lead and armored with iron. Tests were made before and after a test with 12,000 volts; the results are also given of a test made three months after it had been in use with 9000 volts. It averaged about 3400 megohms and 0.13 microfarads per km.—*Elek. Zeit.,* April 20.

ELECTRO-PHYSICS AND MAGNETISM.

Voltage of Induction Coils.—A third paper by Mr. Oberbeck from the *Wied. Ann.* 67, p. 592, is abstracted in the *Elek. Zeit.,* April 20. He describes the results of experiments made to determine the sparking distance and voltage between a point and a plate electrode, connecting the point first with one pole and then with the other. The results are shown graphically in the accompanying diagram in which the abscissas are the distances between the point and the plate in cms and the ordinates the voltage. The curve marked *Sp+* is for the



CURVES OF SPARKING DISTANCES.

case in which the point was positive while for the other it was negative. The absolute values of the voltage are said to have no very great value, as they depend on the sharpness of the point which was used. A peculiar feature was found where the two curves crossed near the origin; the voltage when the point is negative is then smaller than when it is positive, the reverse being true for higher voltages. He also found that for every case and for a fixed spark length there is a certain pressure above which the discharge will only be in spark form; below it, it may be a spark or a brush discharge.—Oberbeck *Elek. Zeit.,* April 20.

Locating Bodies by X-Rays.—A brief description of an exploring radioscope by Mr. Londe, in a French Academy paper, is abstracted briefly in Lond. Elec., April 21; the object is to locate the depth of a foreign body in an opaque one. The apparatus consists of two rings, one above and the other below the body to be examined, the axes of both coinciding. They are moved until the shadows of the rings are concentric and the shadow of the foreign body is in the centre. The points are then marked on the skin at the centre of each ring and the foreign body will be somewhere on the line joining the two points. The tube is then shifted aside a little, thus throwing the body out of the centre. The subject is then removed and a transparent scale inserted in the axis of the rings. That scale will cast a shadow, somewhere on which the foreign body appears. The scale reading against it marks the depth below the skin."—Londe. *Comptes Rendus,* March 27.

Radiography.—Mr. Murani, in *Nuovo Cimento,* abstracted briefly in Science Abstracts, March, states that the metallic reflector is good when used immediately behind a photographic film, but is of no benefit when a glass plate is used, as the glass itself acts as a reflector. Malagoli and Bonacini, in the same journal, p. 97, claim that the metallic backing is necessary in cases even with glass plates, especially when the tube is hard and with focus tubes; otherwise there is a fogging and want of contrast; it is less necessary, however, with glass plates than with films or with soft, pear-shaped tubes requiring long exposures.—*Nuovo Cimento,* 8, pp. 112 and 97.

Duration of Röntgen Radiation.—Mr. Morize found by means of a toothed wheel that each passage of the current in the primary, corresponds with several partial discharges in the tube. The total Röntgen radiation lasting 0.00109 second, each partial discharge requires 0.000082 second and the interval between partial discharges are all equal to 0.00033 second. A brief abstract is given in *Science Abstracts,* March.—Morize. *Comptes Rendus,* 127, p. 546.

Röntgen Rays and High Temperature.—In the *Nuovo Cimento,* Mr. Volta states that a flame in the path of the rays does not appreciably affect their transmission and that an elevation of temperature increases the actinic energy of their secondary radiations in platinum, steatite, and especially carbon. A brief abstract is given in *Science Abstracts,* March. Volta. *Nuovo Cimento,* 8, p. 241.

Absorption of Electric Waves.—Investigations of the screening action of insulators or feeble conductors such as are met with in practical work. It was found that the opacity of the substances to electric waves depends much on their nature, condition and thickness; sand and stone are very transparent, especially when dry; Portland cement is very opaque, and wet sand almost equally so.—Branly and Le Bon. *Comptes Rendus,* April 4; noticed briefly in Lond. *Elec.,* April 21.

Electric Currents in Dielectric Liquids.—According to an abstract in *Science Abstracts,* March, Mr. Naccari states that in dielectric liquids Ohm's law is obeyed and the specific does not vary with the e. m. f. He also found that there was no variation of the resistivity with the area of the electrodes.—Naccari. *Nuovo Cimento,* 8, p. 259.

Electricity and Fog.—Mr. Garbasso states that the fog dispersing effect of an electric charge is due to the charged surface rather than to the field; for if the former be covered with a glass tube even when pierced with extremely small holes, there is no effect. A brief abstract is given in *Science Abstracts,* March—Garbasso. *Nuovo Cimento,* 8, p. 265.

Electrolytes in a Magnetic Field.—Mr. Bagard maintains that the resistance of a given liquid conductor is modified by the presence of a magnetic field, but admits that the specific resistance is not varied thereby; he also describes a method of showing this. He accounts for the effect by supposing that the magnetic field has a definite effect on the flux in the liquid.—Bagard. *Comptes Rendus,* 128, p. 91; noticed briefly in *Science Abstracts,* March.

Distribution of Terrestrial Magnetism.—In an article in *Terres. Mag.,* April, by Dr. Bauer, he endeavors to give a clearer conception of the causes of the unsymmetrical distribution of the earth's magnetism by supposing the earth to be a uniformly magnetized sphere and then deducting this theoretical magnetism from the actual one at corresponding points on the earth. From a chart thus laid out it is shown that there are three residual north poles and three south; the strongest of the north poles is in Patagonia and the others are in China and the United States; the strongest residual south pole is in French Congo and the other in Behring Sea and near Tasmania. The distribution of the irregularities is shown to have some connection with the abnormal distribution of temperatures; a brief abstract is published in the Lond. *Elec.,* April 21.—Bauer. *Terres. Mag.,* April.

Magnetic Charts.—Mr. Mathias, in the *Jour. de Physique,* proposes for charts of comparatively small areas, to represent the difference between the magnetic element at various points, and its value at some fixed observatory in the district, instead of the actual values of the elements.—Mathias. *Jour. de Physique* 7, p. 455; noticed briefly in *Science Abstracts,* March.

REFERENCES.

Röntgen Ray Shadows.—A discussion of what might be called the penumbra.—Villari. *Accad. Lincei. Atti.* 7, p. 291; noticed briefly in *Science Abstracts,* March.

Energy in a Vacuum Tube.—An abstract of the article noticed in the Digest May 6.—Ebert. *Elek. Zeit.,* April 20.

Electric Waves.—A description of a new method of demonstrating electric waves.—Coolidge. *Wied. Ann.* 67, p. 578; abstracted with illustrations in the *Elek. Zeit.,* April 20.

Discharge in Rarefied Air.—A verification that the discharge in rarefied air can be of a continuous form as determined by Hertz method. It is shown, however, that such a discharge emits waves and therefore cannot be considered to be a "stationary" current. He appears to make a distinction between a variable current which is not broken, and one which is continuous and invariable.—Cantor. *Wied. Ann.* 67, p. 481; noticed briefly in *L'Eclairage Elec.,* April 15.

Charges of Rain and Snow.—Descriptions of some observations of the electric charges conveyed by rain drops and snowflakes.—Elster and Geitel. *Terres. Mag.,* March; noticed briefly in Lond. *Elec.,* April 21.

Electric Lines of Force.—A description of a method by which these may be shown with the aid of a powdered inferior conductor sprinkled over a glass plate. Diamidophenol crystals in small needles answer very well, while cork, elder pith, powdered sugar and many other substances may also be used. The curves are fixed with varnish in the usual way.—Boudreaux. *Comptes Rendus,* April 4; noticed briefly in Lond. *Elec.,* April 21.

Slow Oscillations.—An abstract of the article noticed in the Digest May 6.—Koenig. *Elek. Zeit.,* April 20.

Susceptibilities.—Description of measurements of susceptibilities of several metals in the form of fine wires or thin filaments.—Seckelson.—*Wied. Ann.* 67, p. 37; abstracted briefly in *Science Abstracts,* March, and *L'Eclairage Elec.,* April 15.

Earth Currents.—A brief abstract of a lecture at the Royal Institution on the natural and the artificial earth currents.—Ruecker. Lond. *Elec. Eng.,* April 21.

French Physical Society.—The beginning of brief descriptions of the apparatus at the recent exhibition of that society.—Guisot. *L'Eclairage Elec.,* April 15.

ELECTRO-CHEMISTRY AND BATTERIES.

Alkali Plant.—Mr. Kershaw, in the *Eng. & Min. Jour.,* April 29, gives a description of the Hulin process and of the works at Clavaux in Savoy, where this process is used; the hydraulic power there is 2700-hp. In the Hulin process a fused mixture of lead and sodium chlorides is electrolyzed between a carbon anode and a molten lead cathode, the chlorine being liberated and the metallic sodium being deposited on to, and alloys with the lead. The presence of lead chloride in the electrolyte is necessary to prevent the formation of a crust on top of the molten lead, as both lead and sodium are then deposited together. The lead chloride is renewed by electrolysis from a lead anode and this process requires about 12 per cent. of the current. The yield per electrical hp-hour is stated, from older experiments with this process, to be 81 grams of chlorine and 51 of sodium, or 1.85-kg of chlorine and 1.24 of sodium per day of 23 hours. The current efficiency of the process is given as about 69 per cent. and the energy efficiency 41.5 per cent; the comparative figures for the wet process are also given; an estimate of the cost of this and several of the wet processes is given in another table. The Hulin process is less efficient than the others, but there are a number of advantages; the high current density enables a relatively small plant to be used, the output of a given cathode area for instance is 30 times as great as by the wet process; the biproducts are of considerable value; the solutions of sodium hydrate are of high strength and absolutely free from chlorine; solutions of 1.54 sp. gr. have been obtained, thus saving an enormous amount of fuel in the concentration process.—Kershaw. *Eng. & Min. Jour.,* April 29.

Electroplating with Vanadium.—According to the *Zeit. fuer Elek.,* April 23, Mr. Cowper-Coles has succeeded in plating with this metal, which has a silver white color, oxidizes only slowly in the air, and is only slightly attacked by acids and alkalies; 1.75 parts of the oxide of vanadium are heated with a solution composed of 2 parts of soda and 160 of water, heated to boiling and then 32 parts of hydrochloric acid are added. The best results are obtained with 0.02 ampere per sq.cm at 1.88 volts and a temperature of 82° C.; with stronger or weaker currents a reddish brown oxide will also be deposited. The solution after electrolysis becomes dark green and when it has lost the greater part of the vanadium it becomes blue. The best results were obtained with 0.714 per cent. of vanadium acid. It is claimed that on iron, copper and aluminum this coating increases the tensile strength and ductility of these metals, a statement, however, which is questioned; it is suggested editorially that it might be better to use silver instead.—*Zeit. fuer Elek.,* April 23.

Zinc Plating.—The *Zeit. fuer Elek.,* April 23, describes briefly how to plate with zinc. After explaining how the articles should be cleaned, which is very important, it is stated that the bath should have a specific gravity of about 1.135 or contain about 0.23 kg of zinc sulphate per liter; the current density is between 0.016 and 0.032 ampere per sq-cm (about 0.1 to 0.2 ampere per sq.in). The solution should be kept in motion. The plate for replenishing the bath should be covered with cocoanut fibre and with a layer of particles of coke, and on this a mixture of zinc dust with about twice its weight of coke.—*Zeit. fuer Elek.,* April 23.

Pescetto Storage Batteries.—Extracts from what appears to be a complete catalogue containing data of this accumulator as made by an Italian company, are given in the Lond. *Elec. Rev.,* but there are no details as to the leading features of construction of the cell. The capacities in ampere hours at a number of different rates are given in the abstract for three different types. The last one of these is for rapid charge and discharge, and is especially designed for traction; in this the ratio of weight of plates to the weight of the cell complete is 0.76. For the lowest rate of charge 0.69 amperes per

pound of battery complete, which corresponds to 75 hours, the capacity per pound of plates was 6.36 ampere hours for a 5.5-hour discharge, falling to about 6 ampere hours for a 3-hour discharge. For the highest rate of charge 6.9 amperes per pound of cell, corresponding to a charge in 15 minutes, the capacity is 1.83 for a discharge of about 1.5 hours and 1.72 for a discharge of 50 minutes. It is said editorially that these figures can apparently be depended upon. Some further particulars concerning the construction is promised in the next issue.—Lond. *Elec. Rev.*, April 21.

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Production of Phosphide.—A description of his experiments in the production of calcium phosphide with the electric furnace. Its most important property is that it decomposes water, giving a non-inflammable phosphuretted hydrogen.—Renault. *Comptes Rendus*, April 4; noticed briefly in Lond. *Elec.*, April 21.

Calcium Carbide Patent.—The first part of an article on the nullification of the basic Bullier patent in Germany, for the production of calcium carbide. It consists almost entirely of a reprint of the official document.—Borchers. *Zeit. f. Elektrochemie*, April 20.

Silicon and Copper Silicide.—A few notes on the properties and applications of these materials which are now made on a commercial scale by an electrometallurgical process in Germany.—*Zeit. f. Elektrochemie*, April 20.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Wehnelt Interrupter with Alternating Currents.—Messrs. Kallir and Eichberg made a rather elaborate investigation of what takes place when this interrupter is used with alternating currents; they endeavored to find how the interruption proceeded and the difference of the action in the two half-periods. They used a synchronous motor to which was secured a disc carrying a Geissler tube mounted radially; the terminals of the tube were connected with the secondary of the induction coil; in this way the polarity of the discharge and to a certain extent the amount could be seen, as also the time and number of discharges, as the tube was illuminated only in certain positions. With a comparatively high resistance in circuit they obtained a discharge only during a half-period; the discharges were in pairs, one due to the decrease of current and one to its increase. Reducing the external resistance increased the number of discharges in each of the half-periods. Those resistances were not inductive; with an inductive resistance in the primary circuit the phenomenon was changed appreciably as shown by diagrams; the discharges during one of the half-periods were much more powerful in that case than during the other half-periods. Of the four different kinds of discharges during the whole period, three are weakened by the introduction of inductive resistances, while the fourth which corresponds to a decrease of the current in the first period, is appreciably increased. The uni-directional discharge from the alternating current is therefore caused by the inductive resistance. They then discuss the nature of the process of interruption as shown by their results. The action of inductive resistance is to diminish the rapidity of the growth or establishment of the current after an interruption and thereby it diminishes the secondary induced e. m. f.; it also affects the process of the breaking of the current, for the larger the number of disappearing lines of force in the primary and the faster they disappear, the greater will be the induced e. m. f. They also refer briefly to the action of this interrupter with a continuous current. If the platinum point is the cathode a bluish white light will be produced, while if it is the anode there will be a reddish light; a spectrum analysis shows the platinum lines in the first case while a continuous spectrum is obtained in the second; in the first there is therefore vaporization of the platinum while in the second the light is merely a glowing. The interruption also depends on the pressure and temperature of the liquid; with an increase of temperature the current will diminish; an alternating current of 2.6 ampere at 16° diminished to 1.7 at 71° and to 0.4 at 100°; the discharges are similarly weakened, but even at boiling temperature the light in the cell and in the vacuum tube still existed; the discharges in the tube become uni-directional with increase of temperature. By increasing the pressure the current in the interrupter will be increased; 2.85 amperes at normal pressure became 3.15 at a 220-mm increase of pressure of mercury; the appearance of light in the interrupter and the tube was thereby stopped.—Kallir and Eichberg. *Zeit. fuer Elek.*, April 16.

Diffraction Galvanometers.—In a French Academy paper, noticed briefly in the Lond. *Elec.*, April 21, Mr. Weiss describes a means which he has devised for considerably increasing the sensitiveness of a galvanometer reading by means of diffraction. He uses a mirror 1 x 0.4-cm in area with its greater length horizontal; the centre is blackened while the ends, 4-mm x 3-mm, are left bare. The radius of curvature is 4-m. The light from an incandescent filament is used and the rays reflected by the mirror produce the usual phenomena of diffraction; the enlarged image of the filament is seen in the focal plane traversed by two black fringes which are sharply defined; using one of these as a zero line a micrometric eye-piece would easily show a displacement of 0.025-mm, which is less than a second of arc and is at least four times as sensitive as the usual method.—Weiss. *Comptes Rendus*, April 4.

Improvement in Regulating Resistances.—An interesting improvement (though probably not new) is described in *L'Elec.*, April 15; the object is to enable a step by step resistance to be varied within smaller limits than by the separate resistance between two adjacent blocks. This is accomplished by securing to the lever arm or crank which moves over the contact blocks, a U-shaped piece of metal insulated from the crank, and so placed that the two ends come in contact with the two neighboring blocks to the one on which the crank rests. In this way it will be seen that the two resistances on either side of the block on which the crank rests, are placed in multiple. The relative positions of the main contact block and this U-shaped piece are such that the latter need not necessarily touch blocks while the crank is making contact, but may be made to do so. All the previous steps are therefore obtained with an equal number of intermediate steps; the number of steps is therefore double the original less one, as there cannot be an intermediate step at the last one.—L'Elec., April 15.

REFERENCES.

The Induction Coil.—After a brief historical introduction, in which he gives Ruhmkorff credit for its invention, he begins the discussion of interrupters. In describing the Wehnelt interrupter he gives a series of interesting current waves of the primary current obtained when this interrupter was used, under various conditions of the circuit.—Armagnat. *L'Eclairage Elec.*, April 15.

Wheatstone Bridge.—A description of a simple method to deduce the relations of a bridge for the case in which there are e. m. f.s in the branches but not in the diagonal. In this way he explains th principle of the Mance method.—Dufoe. *Jour. des Physique*, p. 16; noticed briefly in *L'Eclairage Elec.*, April 15.

Measurement of Small Inductances.—An abstract of the article by Martienssen, noticed in the Digest March 25, which appears to be better than the abstracts previously noticed, and contains some of the formulas, is given in *Science Abstracts*. March, p. 182.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Ultra-Violet Light Telegraphy.—In the *Sc. Am.*, April 29, Prof. Fessenden refers to the method of Zickler for telegraphing by means of ultra-violet rays, which was duly described in the Digest, and adds that he, Fessenden, invented that system more than 10 years ago. He used a much more sensitive receiver, namely, the human eye, which will detect an amount of energy that would have no action on a vacuum tube. The receiver was a circular dish of a fluorescent substance with a reflector placed slightly above it to focus the rays on the surface. All visible rays were stopped. The reason why the system was never put on the market was that such rays are very rapidly absorbed, especially over water, and when there is a fog in the air. He does not believe that Zickler will succeed for distances of a mile; even with the eye instead of a vacuum tube he thinks the limit will be about two miles. He abandoned this method in favor of one using infra-red rays, which is much more promising, although he is skeptical about its practical use.—Fessenden. *Sc. Am.*, April 29.

REFERENCES.

Zickler System of Light Telegraphy.—A translation of the article noticed in the Digest May 6.—*Sc. Am. Sup.*, May 6.

Telegraph and Telephone Wires of the World.—An interesting table of statistics given in a recent paper by Mr. Gavey is published in the Lond. *Elec.*, April 14. It is from official sources and is presumably the same as was recently noticed in the Digest. Including the lines owned by railway companies and the submarine cables, the total length of lines at the end of 1898 in the whole world was 2,029,893 miles. The total length of wire was 8,285,400 miles.

Signalling on Single Line Railways.—A short description from the *Railway Engineer*, March, describing the system devised by Hollins of the Great Eastern Railway.—Lond. *Elec. Rev.*, Jan. 21.

Fuses for Telephone and Telegraph Lines.—A brief illustrated de-

scription of the Mattausch system mentioned in the Digest April 29. —*Elek. Zeit.*, April 20.

MISCELLANEOUS.

Effect of Heat and Light on the Body.—A short article by Dr. Hedley in the Lond. *Elec. Rev.*, April 21. He speaks of the beneficial effects of the application of heat to the body in the cure of diseases, but argues that it is much better to use the heat which proceeds from a luminous source, in place of the direct application by contact or by heated air. He points out the advantages of using the electric light for this purpose. Every tissue of the body, he says, is permeable to light, including the skin, muscles, tendons and bones. "Light permeates the tissues and is stored up there." Light also influences the nervous system, the nutrition of the cell and the composition of the blood; he has used the arc light systematically for this purpose; it diminishes pain in neuralgia, sciatica and lumbago and is useful in rheumatism; its action on ulcers and lupus is said to be favorable. It is also stated by others that electric welders are comparatively free from rheumatism.—Hedley. Lond. *Elec. Rev.*, April 21.

Frequency and the Sensation of Feeling.—The Lond. *Elec. Eng.*, April 7, contains a short abstract of an article in *Science*, by Mr. Scripture on the anæsthetic effects of a sinusoidal current of high frequency. He found that such an effect can be produced by passing the current longitudinally along a nerve. For a frequency of 29,000 complete periods per second, no sensations of taste are produced by an alternating current. He also found the following: "Threshold of sensation of touch at a frequency of about 480 complete alternations per second; threshold of disagreeableness at about 840; threshold of pain at about 960; disappearance of pain at about 1440, followed by a peculiar agreeable sensation; disappearance of agreeableness at a point not yet determined, followed by a faint sensation; disappearance of sensation at a point not yet determined." The probable error is claimed to range between 4 per cent. and a fraction of 1 per cent.—Lond. *Elec. Eng.*, April 7.

REFERENCES.

Death by Electric Current.—Reprints of two Academy notes. The first one was noticed in the Digest April 22, and describes experiments with alternating currents. The second deals with similar experiments on animals with continuous currents.—Prevost and Battelli. *L'Ind. Elec.*, April 10.

New Books.

ELEMENTARY PRACTICAL PHYSICS. A Guide for the Physical Laboratory. By H. N. Chute, M. S. Boston: D. C. Heath & Co. 387 pages, 274 illustrations. Price, $1.25.

This little book is intended for teaching physics by the laboratory method to students in high schools or colleges. It has chapters relating, respectively to the properties of matter, the mechanics of solids, the mechanics of fluids, heat, magnetism and electricity, sound and light. The appendices cover 40 pages, and relate to apparatus and reference tables. There are practically no mathematics in the book. The tables contain a curious mixture of the metric and ordinary systems of units. The book concludes with a fairly copious index. Within the limits laid down by the author, the treatment is good, but several of the chapters should be brought up to date, in view of the developments which have taken place during the last ten years.

BOOKS RECEIVED.

PREMIERS PRINCIPES D'ELECTRICITE INDUSTRIELLE. By Paul Janet. Paris: Gauthiers-Villars. 280 pages, 169 illustrations. Price, 6 francs.

Maximum Demand Meters.

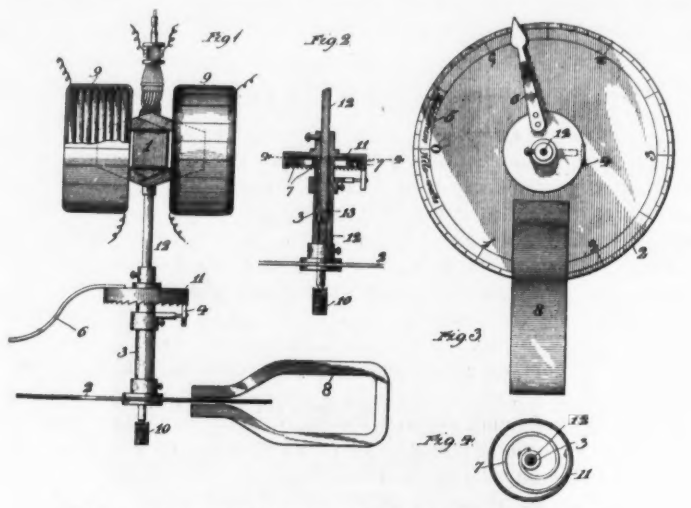
BY EDWARD S. HALSEY.

The great interest taken for the last year or so in a discount system based upon the maximum demand, has turned the attention of inventors to the construction of some device that would fulfil all the requirements of such a system.

The requirements are, besides cheapness, accuracy, durability, simplicity of construction and operation, that the meter must record accurately on all conditions of load on a three-wire circuit; should be applicable to either direct or alternating currents; must operate gradually so as to require say from two minutes to an hour to reach its maximum effect in order to guard against short circuits or accidental overload; it should also record properly on intermittent loads —for example, on direct-coupled elevator work.

Of the several devices previously brought out some have been magnetic ammeters carrying a stylus, tracing on a chart; in others, the indicator becomes engaged by some mechanical device which retains it at its maximum indication. Some are retarded by working against the well known glycerine dash-pot. Another principle applicable to this work is the heating effect of the current when passed over metal strips; although a maximum meter involving this principle, has several decided drawbacks, it is probably the most suitable now in use. It has been found impossible to construct a three-wire meter on this principle working on a single scale, on account of the difference between the C^2R losses in one of the strips as against that of both strips with an equal total current divided between them.

While a thermal electric meter has a decided advantage in coming up slowly on account of requiring time to become heated, this same property disqualifies it for work on intermittent load that is not at a maximum long enough to heat the instrument up to a maximum temperature, since each time the load goes down or is cut off, it has



FIGS. 1 TO 4.—DETAILS OF MAXIMUM DEMAND METER.

a chance to cool down, and the next time current it thrown on it has to start over again from the bottom.

The meter illustrated herewith has a novel device in the way of an attachment to integrating supply meters of standard makes now in common use. It not only conforms to all the enumerated requirements, but at the same time does away with the individual maximum meters altogether; moreover, by its use the integrating meter, which would be used in either case, and without in any way effecting its regular function of recording the watt hours consumed, registers most accurately in addition the maximum watts used.

The importance of this invention will be realized when it is seen that by it the saving is made of two maximum meters for each three-wire meter, and in addition to first cost, storage, connecting up and testing, cartage, wall space per installation, reading and repairs.

It is obvious also that with two separate maximum meters, one on each leg of a three-wire circuit, the sum of their indications will not in all cases be the true maximum demand.

The principle of this new device is briefly as follows: The upper or motor part of the meter carrying an indicator is flexibly coupled to the lower or drag portion, which carries with a kilowatt scale; a pawl and ratchet prevent relaxation of the spring coupling, and a viscous dressing at shafts junction acts as a retarding agent and permits sluggish action.

Fig. 1 will at once be recognized as the essential working parts of a Thomson integrating wattmeter, with the attachments for the maximum recorder attached thereto. Fig. 2 is a partial sectional view of the lower parts. Fig. 4 is a cross-section through the line 4-4 of Fig. 2, looking down from above. Fig. 3 is a plan view of the copper disk, 2, with the kilowatt scale marked on it, showing also the indicator, 6, the rachet wheel, 11, the gravity pawl, 4, and the magnet, 8.

This attachment is made to the meter in use whether direct or alternating, or of the commutator or induction type, in the following manner, as is shown best in Fig. 2. The shaft is cut in two about one-half inch above the drag disk, and to the lower portion is secured

the sleeve, 3, the end of the upper fraction of the shaft is run down to a point, 13, and this part of the shaft is perfectly free to turn in the sleeve and has fixed to it the flanged ratchet wheel, 11, which in turn is coupled to the top of the sleeve, 3, through the medium of the spiral spring, 7, which is best shown in Fig. 4. Thus the upper or motor portion is flexibly coupled to the lower or dragging portion. As a retarding agent, a small quantity of a viscous material is inserted in the sleeve and then the shaft point is pushed down into it.

This material is of such a consistency that it will not ooze out if the meter should be left standing in an inverted position; it produces no positive friction but acts as a retarding agent, allowing the indicator to reach its maximum effect in from three to five minutes, does not alter in character with time, and, if desired, can be so applied as to increase or decrease the rate of movement.

This material held by capillary attraction in the space between the sleeve and the shaft acts as a dense lubricant, preventing positive friction to such a degree that the torque of the starting coil of a Thomson meter is sufficient to make a definite indication. Of course, this middle bearing has but half the weight on it that the bottom one has; still it is interesting to note that the indicator will move with less torque than is required to revolve the disk.

The proportions of several features are somewhat exaggerated in the drawings for the sake of clearness of illustration. For instance, in reality there are about 300 teeth in the ratchet wheel; the space is

FIG. 5.—50-AMPERE, 115-VOLT MAXIMUM DEMAND METER.

quite close between the shaft and the sleeve; the spring is thin and long; and the index finger is thin and flexible, so that it can be sprung down to the scale. The increase in weight to the revolving parts in the case of a Thomson meter is 4 per cent. The spring is adjustable at its outer end so that calibration is a simple matter.

The accuracy of this indicator may be realized from the facts that the armature torque is always in direct proportion to the load passing through the meter, regardless of speed, of rotation, even if the drag portion were stuck so that it could not move; next, the drag is always equal to the torque whether the meter is fast or slow, or the magnets are weak or strong; the two parts are coupled by a spring, the amount of torsion of which is always equal to the strain applied.

The meter shown in Fig. 5 is of 50-ampere, 115-volt capacity; the scale is divided into six kilowatt divisions, which are divided into 100 watt divisions. The maximum indication at full load for this meter would be $115 \times 50 = 5750$ watts, or nearly one revolution of the pointer in relation to the scale.

There are several notable points in this instrument, some of which are the extremely long scale, about 15 inches; equal divisions of the scale, for if corrected at one point it is correct at all points; the correct registration of overload by starting on the second lap, as will be noticed at once when setting it back to zero. The simplicity of which operation is also noteworthy.

The plan proposed for the introduction of the device is to contract with the electricity supply companies, sending meter experts to their various test and repair departments to apply the attachment to the meter now in use, at the same time giving the meters a general testing. Also to make royalty contracts with meter manufacturers to apply the device to new meters.

Manufacture of American Electric Railway Apparatus in England.

Some time ago it was suggested by the present writer that large as were the present electrical exports, it must not be expected that they could go on growing at the same rate, as the point would soon be reached where it would pay to make these goods in large quantities abroad, particularly in England. Events during the past few months have gone far to verify this prediction, and now comes the news of a movement which takes on the character of a historical event. It is evident that the psychological moment has arrived in English electric railway development when an outburst of activity may be seen equal to that in America ten years ago and when apparatus will be required in a volume for which present productive capacities are utterly inadequate. Thus it happens that a new corporation is being formed in England whose object it is to build generators, motors and car controllers for this branch of industry; and the syndicate comprises Dick, Kerr & Co., Ltd.; John Kerr, George Flett, C. T. Cayley, B. Sykes, T. S. Turnbull, R. Prestwich, J. Prestwich, G. Readman, W. J. Kirk and Prof. S. H. Short. The capital for the enterprise, namely, $1,000,000, was swiftly subscribed, and no allottment of less than $50,000 was considered, so numerous were the applications for stock. This confidence in the project is due to the leadership of Dick, Kerr & Co., whose names have been so prominently associated with street railway work throughout England and the Continent, and who lately organized another successful syndicate to create the Electric Tramway and Carriage Company, of Preston, Lancashire, where street railway material is turned out in enormous quantities. To Americans, however, the leading feature of this new departure is the fact that Prof. Short is to be the technical director of the new company, and will henceforth live in England. The only parallel to this removal of a first-class engineer and inventor to England that comes to mind is presented by Mr. Hiram Maxim, and it is equally a matter of regret that Prof. Short should find sufficient inducement to spend his time abroad in this manner. At the same time, the incident can but be taken as complimentary to American initiative in the new electrical industries that dominate the closing years of the century.

For some weeks past Messrs. Flett, Turnbull and other leading members of the syndicate have been in this country carrying out arrangements for their new enterprise and buying machinery for the shops to be established at Preston. Mr. Flett when interviewed on the subject, and asked why America supplied both talent and machinery for the work, said:

"We have been prompt to recognize the fact that in this country you have developed the electric railway art to such an extent as to have standardized it. For us to do the experimental work over again would be foolish, and it would not be the English way. We are slow to change settled conditions but quick to learn a lesson. In England it is now realized that to meet the necessities of passenger travel in the streets, there must be electric cars with trolley lines or preferably in city centres with the slotted conduit. In this way the congestion of street traffic is going to be greatly reduced and the accessibility of the suburbs will be increased marvelously. We propose to do the bulk of that work."

"What are your preparations?"

"Our new factory at Preston adjoins that of the Electric Tramway and Carriage Company, and we propose to begin work in it next January at the latest. We have eleven acres of ground, and the first buildings put up will cover nearly five acres. The main machine shop will be 900 feet long by 120 feet, with two bays. The foundry will be nearly 500 feet long by 80 feet, and there will be the usual subsidiary buildings and offices. There will be eight electric cranes in the works, two 40-ton, three 30-ton and three 15-ton. In fact electric power will be a leading feature all over the works. Westinghouse generators will be installed driven by engines from the Musgraves, of Bolton, Lancashire, and current will be furnished to 600-hp of Westinghouse motors ranging from 5-hp to 50-hp. It will be, if I am not mistaken, the largest electric power installation in England."

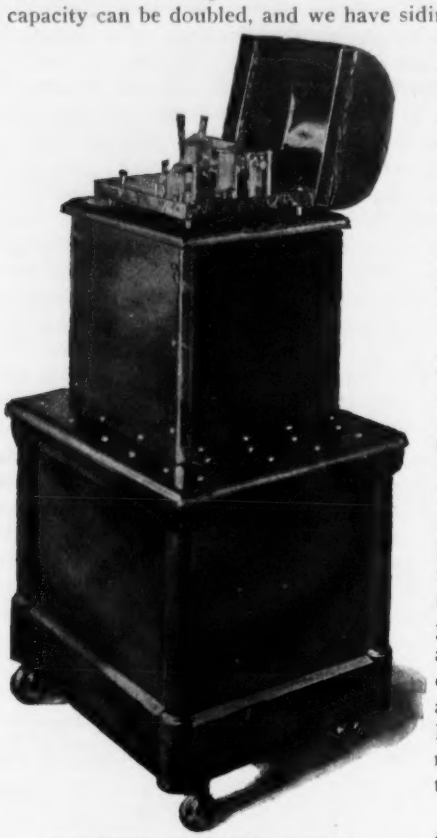
"And as to tools?"

"Well, we recognize the fact that the demands of this work have led to the production in America of just what we want, and we have been placing orders for well up to $200,000 for that class of machinery, the precision and adaptability of which has pleased us very much. We hope to get good results from it. Among the orders we have given out are those to the E. W. Bliss Co. for presses and to

Kemp-Smith Co. for milling machines. We must be prepared for a large output."

"What will your capacity be?"

"At the start, we shall be able to manufacture about 1,200 car equipments per annum in motors and controllers, and about 30,000-kw in generators, employing about 1000 hands. So far the demand for big generators like your 5000-hp has not existed in England, but we hope to see it pushed up to that point, and, of course, we have all the colonial trade open to us. Our works are so arranged that the capacity can be doubled, and we have sidings from the Lancashire & Yorkshire and the London & Northwestern Railways, so that we can ship even the heaviest parts very easily."



TELEPHONE GENERATOR CABINET.

"Outside of the opinion expressed in your purchase of American machinery, have you formed any convictions during your present trip?"

"I have been particularly well pleased," said Mr. Flett with strong emphasis, "to note how well the conduit street car systems work. I am entirely satisfied that in the crowded centres of such cities as London and Manchester, where we have now a traffic congested far beyond anything you have any idea of here, the conduit system is far preferable to the overhead trolley, good as that is for many towns and districts."

Prof. Short, who returned with Mr. Flett and party, stated that Mr. S. B. Fortenbaugh went with him as chief technical assistant, and that probably other engineering skill might be secured from this country. The visitors left by the "Lucania" on May 6, and a farewell dinner in their honor was given by friends at the Engineers' Club. On their arrival home, no time will be lost in pushing things.

Telephone Generator Outfit.

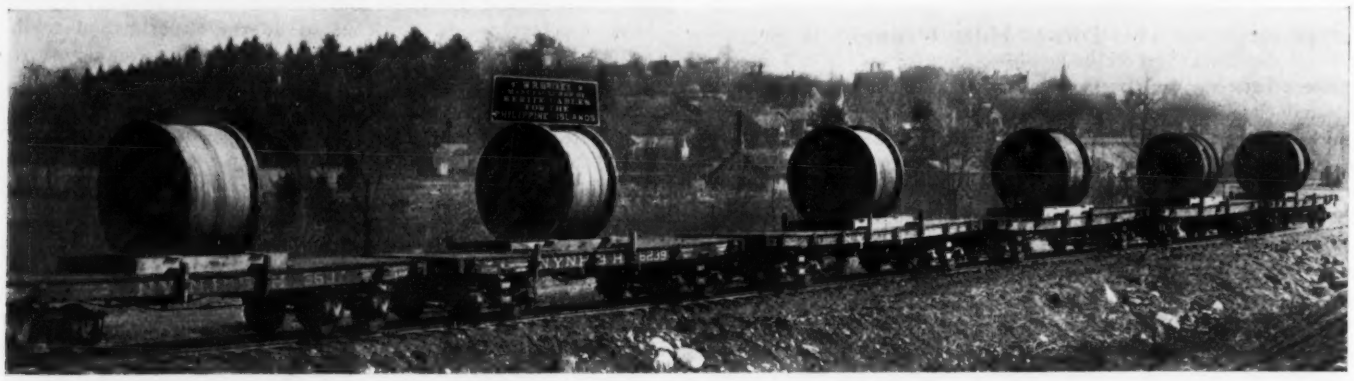
The first of the above illustrations shows a new telephone generator outfit recently placed upon the market, the purpose of which is to take the place of power magneto generators used in telephone exchanges in signaling to subscribers. The ringing power is obtained from batteries, which are placed in the lower part of the cabinet. The machine consists principally of a special vibrator with large platinum contacts. The vibrator is kept in motion constantly and may be adjusted for different rates of vibration. The manufacturer of this machine, the W. F. Warner Company, Muncie, Ind., claims that this is the cheapest method of obtaining power for the purpose mentioned. This apparatus, it is stated, lasts a long time without any attention and is equally suitable for large and small exchanges.

Kerite Cable for the Philippines.

Reference has already been made in these pages to the important work of the United States Signal Corps, whose duties during and since the war with Spain have taken on a scope and magnitude that were unexpected before that eventful period in our national history. The latest development of this new work has been the enterprise of laying and operating submarine cable. The results obtained during the Cuban campaign were so encouraging as to warrant the government in going several steps further when the troubles in the Philippines developed, so that last week a Signal Corps expedition started out from New York City on the "Hooker" for the Philippines, laden with American submarine cable, for the purpose of connecting up the six principal islands in the group. A large portion of the material shipped consisted of thirty miles of Brixey's Kerite cable, for which the order was secured by Mr. G. F. Porter.

When General A. W. Greely, of the United States Signal Service, awarded the contract to W. R. Brixey for deep-sea submarine cable, for government service in the Philippine Islands, it was something more than an ordinary order, as it was part of the first order ever given to an American manufacturer for deep-sea cable, and the specifications issued by the government for its construction were extremely rigid, calling as they did for not less than one thousand megohms insulation resistance to the mile, and a pressure test of five thousand volts. The Kerite tests ran up to 1500 megohms per mile. The core of the cable is made up of seven No. 21 B. & S. gauge tinned copper wires, stranded together and covered with a thin layer of pure Para rubber, then insulated with Kerite compound to an outside diameter of nine thirty-seconds of an inch. Over this is a covering of tape, and then layers of jute are added until the core is of a size to be covered closely by sixteen No. B. W. G. galvanized iron armor wires, laid spirally. These armor wires are then covered with two layers of tarred jute, wound on in opposite directions. This jute, by the way, was grown in the Philippine Islands, and is now returned, after more than circumnavigating the globe, to connect these islands one to the other.

The completed cable will weigh about three tons to the mile, and has a total outside diameter of one inch. The cable was built at the Kerite factory in Seymour, Conn., by W. R. Brixey, and was shipped on reels, in lengths of five miles each, to Harlem Dock, New York, where it was joined in one length and loaded upon the United States transport "Hooker," which sailed for the Philippines via the Suez Canal on May 1, "Dewey Day." It will be laid under the supervision of Lieutenant Colonel J. E. Maxfield, an officer who has had considerable experience in signal service, and who has been specially selected to take charge of this work.



TRAIN LOAD OF PHILIPPINE CABLE.

Our engraving made from a photograph for which we are indebted to Mr. Brixey, shows the cable en route from the Kerite factory to the seaboard. It may be questioned whether deep sea cable was ever before made so far inland and shipped for its destination with so much care as was the case upon this occasion.

Direct Reading Volt-Ammeter.

The apparatus illustrated herewith has been produced to meet the demand for an accurate and reliable instrument of low price. Its range is 20 volts and 15 amperes, and the instrument is suitable for laboratory work, storage batteries or any work where batteries are used, within the capacity of the instrument.

In order to render it durable the instrument is provided with hardened steel bearings. The scale is mirrored to prevent errors due

A BATTERY DIRECT-READING VOLT-AMMETER.

to parallax, and is marked in two colors to assist in taking readings; the binding posts are also of different colors, to prevent confusion in making connections, and the case is of aluminum and mounted on a mahogany base. The instrument is manufactured by the Ziegler Electric Company, Boston, Mass.

The Diesel Heat Motor.

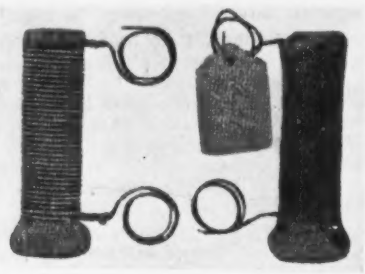
The principles governing the action of the Diesel motor have been familiar to mechanical engineers and students of thermodynamics for a number of years, but it was left for Mr. Rudolph Diesel, of Munich, Germany, to successfully develop these theories and produce a practical heat engine. The successful development of this engine, showing, it is stated, double the efficiency of the best triple-expansion steam engines and 50 per cent. greater efficiency that the hitherto best gas or oil engines, has recently attracted great attention among engineers throughout the world.

It is claimed by those interested in the manufacture of the Diesel motor that it will revolutionize the methods of generating power, and that an installation of 1000-hp in Diesel motors, divided into any size units, will show a higher efficiency than a modern central station of the same capacity distributing its power through the medium of transformers and electric motors.

The American rights for the engine are controlled by the Diesel Motor Company of America, whose executive officers are Mr. Adolphus Busch, president; Mr. Hugo Reisinger, secretary, and Col. E. D. Meier, engineer-in-chief. It is asserted that the results reached by Mr. Diesel will be equaled, if not surpassed, in the American type engine now offered to the public.

Standard Resistance Units.

A complete line of standard resistance units which will be useful in all branches of the electrical business has been recently placed upon the market. A typical unit is shown in the accompanying illustration. In its construction a wire is first wound upon the surface of a special pottery tube and substantial terminal leads are placed upon the tube to hold the resistance wire in position. The entire tube is then given a coating of enamel which holds the wire in position and protects it against mechanical, chemical and electrical injury. In the illustration the figure at the left shows the tube with its resistance wire, and the one at the right shows the completed unit.



TYPE "B" RESISTANCE UNIT.

These resistance units are made in three capacities, namely, 36 watts, 72 watts and 125 watts, for continuous duty, designated as A, B and C sizes respectively.

The Ward Leonard Electric Company, of Bronxville, N. Y., manufactures these units and carries in stock 26 standard windings of each size, varying from 1000 ohms to .15 ohm by an evenly graded series, and the ampere capacity varying corresponding from one-quarter ampere to 30 amperes.

These units can be readily mounted on the back of a slate by means of small bolts passing through the centre of the tubes. It is stated to be impossible for these units to become grounded, since the tube is composed entirely of material possessing high insulating qualities. By the use of the resistance units and guided by the comprehensive tables furnished by the Ward Leonard Company, giving the ohms, amperes, volts and watts of each unit, it is possible to construct a rheostat with any desired number of steps, of any desired watts capacity and any desired graduation in ohms or in amperes.

A Canadian Electric Vehicle.

An electric "motet" has been running over the Canadian roads, which are just thawing out after the severe winter, and, it is said, surmounting grades of 10 and 12 per cent. with a live load of about 400 pounds, running through 7 and 8 inches of mud. The manufacturer of this vehicle, the Canadian Motor Syndicate, of Toronto, Ontario, has given this rig these severe tests and states that it has never been found lacking in power to surmount grades and overcome obstacles liable to be met with in the course of actual work. The total weight of the vehicle is 400 pounds, including that

ELECTRIC "MOTET."

of the battery, which is 180 pounds. The battery is of the Still patent. The vehicle has a seating capacity for two persons and space for 50 pounds of baggage. When used as a light delivery wagon, it has a carrying capacity of 250 pounds, including the weight of the driver. Its speed is from 12 to 15 miles an hour, and it has a range, on one charge of the battery, of 30 miles. Steering is accomplished by the hind wheel, the vehicle being of the tricycle type. Power is supplied by a special motor designed by Mr. W. J. Still, which is stated to give 3½-hp per 70 pounds weight. On ordinary

roads the current consumption is rated at 15 amperes, and the cost of operation is said to be one-half cent a mile.

The Shepherd Engine.

The Shepherd vertical automatic engine, illustrated herewith, has been designed with a special view to direct connection to electric generators and other fast running machinery, such as fans, pumps,

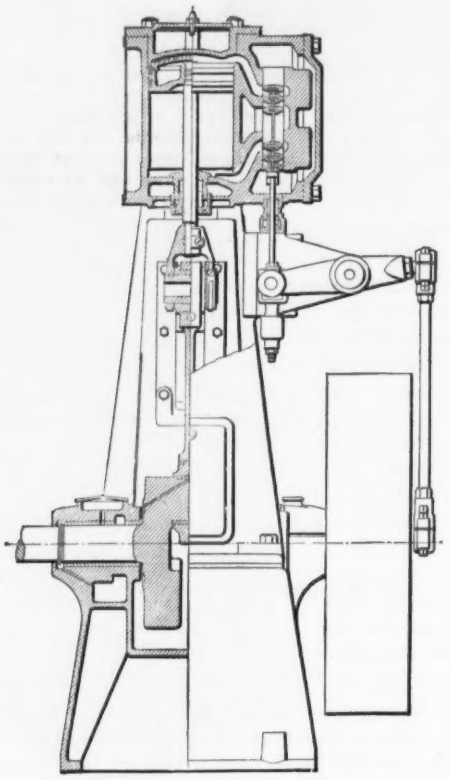


FIG. 1.—SECTIONAL VIEW OF SHEPHERD ENGINE.

blowers, etc., but, of course, can be run at more moderate speeds for factory, mill and other uses.

The claims made for this engine are that it combines with simplicity of construction and symmetry of form, the greatest degree of rigidity and strength; that while it represents concentrated power in the minimum space, convenience and accessibility to the working parts have not been sacrificed in obtaining compactness, nor simplicity gained at a loss of efficiency; that it is compact in the sense of being convenient and easy of access without any waste space, and at the same time rigid and self-contained; that it is simple, consisting of but few parts and all wearing surfaces are provided with the most accurate adjustment for taking up wear; and that the engine is clean and neat in operation, as not a drop of oil need be thrown about on the engine room floor or walls.

The bed and frames are of cast iron, well ribbed and braced, and contained within are the cross-head guides, the main bearings, and the valve gear support, thus insuring the working parts remaining of line adjustment for wear being provided. The back frame, which contains the guides and the rocker-arm bracket, supports the cylinder when the front frame is removed to take out the crank shaft, should it ever be desired to do so. The cylinder and steam chest are cast together. The cylinder barrel, and both top and bottom heads, are jacketed with an air space or a non-conducting material.

The valve is double ported for both steam and exhaust and is self-adjusted for steam tightness, all wear being thus automatically followed up. It is also collapsible, and acts as a relief valve in case of water in the cylinder.

The governor is of the Shepherd type, for which remarkable results are claimed in the way of close regulation, and for the combination of simplicity with freedom from dirt; no oil is used about the governor, and there is no noise or pounding even after long use.

The crank shaft is counterbalanced, and of solid steel. The crank pin and main bearings are of liberal proportions, and are automatically oiled by means of ring or chain oilers, which keep a continuous stream of oil running over them at all times. The piston rod, connecting rod, valve and eccentric rods, pins, bolts, etc., are all of steel, accurately machined. The cross-head is of phosphor bronze or cast steel.

The Shepherd vertical automatic engine is built by The American Fire Engine Company of Seneca Falls, N. Y., and is made in both simple and compound types; the latter, both cross and tandem styles, being adapted either for belted or direct connection.

Economy of Mechanical Draft.

The possibilities in the way of reduction of fuel cost in modern boiler practice by the introduction of mechanical draft, are well exemplified by the accompanying results obtained at the United States Cotton Company, Central Falls, R. I. This record covers a period of 52 weeks. The number of hours run was 2998, with an average indicated horse-power of 1543.84:

Mixture.	Composition. Per Cent.	Pounds Burned.	Cost.
Buckwheat	78	6,074,400	$7,316.89
Anthracite Coal	15	1,173,826	800.34
Cumberland	7	565,906	836.00
Total	100	7,814,132	$8,953.23

This gives a cost per ton of $2.29, and a cost per I. H. P. per year, of $5.80.

The plant consists of three Babcock & Wilcox boilers of 335 rated horse-power each, a total of 1005 rated horse-power. The engine is a cross-compound Harris-Corliss, developing, as will be noted, an average of 1543.84 indicated horse-power. The remarkably low fuel

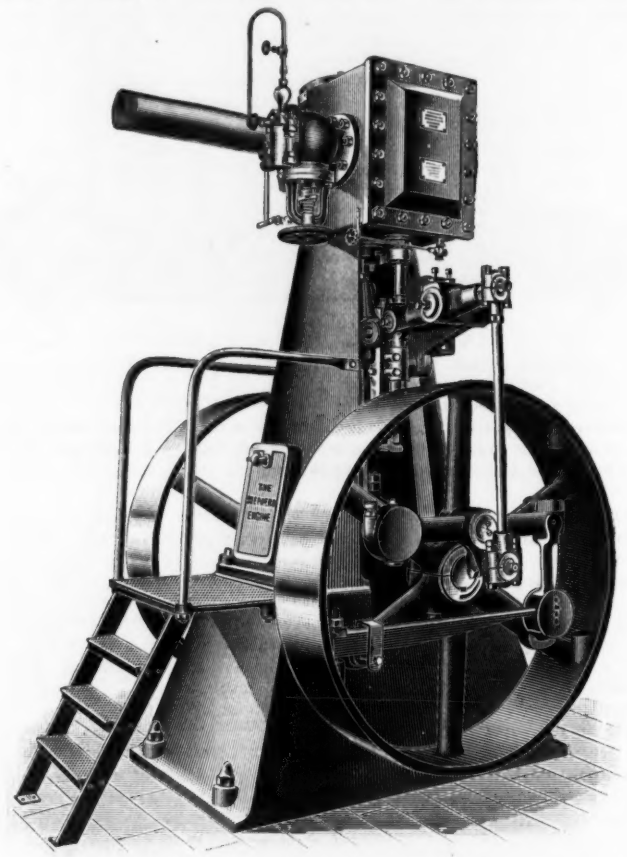


FIG. 2.—SHEPHERD VERTICAL AUTOMATIC ENGINE (75 TO 200-HP.)

cost of $5.80 per I. H. P. per year in a plant without economizers is primarily due to the employment of a low-grade mixture, costing only $2.29 per ton, the burning of which has been rendered possible by the introduction of mechanical draft. The draft of the chimney which has been previously employed, lacked the intensity necessary to the free combustion of this fuel, and as a consequence it has been necessary to use Cumberland semi-bituminous coal.

The installation of the fan, costing less than $600, brought about an annual saving of no less than $6500 in the fuel bill. The fan, which was built by the B. F. Sturtevant Company, of Boston, is provided with a direct-attached engine, the speed of which is regulated by a device of the chief engineer, Mr. Thomas P. Burke, whereby a scarcely perceptible change of steam pressure, immediately alters the speed of the fan and consquently the intensity of the draft, and instantly brings the pressure back to normal. As a result the steam pressure remains almost absolutely constant.

NEWS OF THE WEEK.

Financial Intelligence.

STORAGE BATTERY STOCK INCREASE.—By a stock vote there has been authorized the increase of $4,500,000 par value common stock of the Electric Storage Battery Co. making the total capitalization $18,000,000.

INDEPENDENT TELEPHONE MANUFACTURE.—We are informed that options have been extended until June 1, by the manufacturers invited to sell out for consolidation, and that there is great likelihood that the proposed deal will then go through on the original lines.

BELL TELEPHONE IN NEW ENGLAND. During the last twelve years the Bell telephone service in the New England States of Massachusetts, Maine, New Hampshire and Vermont has increased 490 per cent. in miles of exchange wire, 180 per cent. in subscribers, and 142 per cent. in net earnings. During the period a bonded debt has been created of $3,549,000 and over $4,800,000 has been charged to construction.

THE COLUMBIA ELECTRIC VEHICLE COMPANY, with a capital of $5,000,000, has been incorporated at Trenton, N. J. The company is empowered to manufacture and operate vehicles driven by electric or other power. The incorporators are Charles A. Wendell, Andrew H. Scobel, Anthony N. Jeshera, Sherman M. Granger, Francis R. Foraker, Walter T. Dryfoos, and Roland B. Harvey, all of New York, and W. B. Greely, of New Rochelle.

MICHIGAN TELEPHONE.—The gross earnings of the Michigan Telephone Co. for the three months ending March 31 will show an increase exceeding $25,000 over the three months ending Dec. 31. Based upon the earnings of March the company will earn at least 6 per cent. for the year 1899, above all fixed charges. The rapid development of the property under the Erie management is the cause for the excellent showing. The net gain of subscribers to March 31 of this year has been 3120. The Michigan Co. is capitalized to-day less per subscriber than any other Bell Telephone Company in the United States, there being only $2,500,000 of stock issued, and of the total bond issue up to date only $900,000 has been used, making a total liability, calling the stock par, of $3,400,000 for the entire system in the State, represented by real estate valued at $300,000. 22,000 subscribers and 35,000 miles of wire.

A BEARING METALS CONSOLIDATION is on foot, including many concerns that make bearings for engines, etc., brasses, anti-friction metals and the like. The following concerns will probably go in, viz.: The Hunt Manufacturing Company, of Newark, N. J.; Paul S. Reeves & Son, Philadelphia; the Damascus Bronze Company, Pittsburg; Fulton Iron & Engine Works, Detroit; United States Bronze Company, Chicago; Hewitt Manufacturing Company, Chicago; Buffalo Brass Company, Depew, N. Y.; Milwaukee Brass & Copper Company, Milwaukee, and Mcre, Jones & Co., St. Louis. The Ajax Metal Company and possibly the Brady Metal Company are among those that are said to be likely to stay out. The new concern will have about $2,100,000 preferred stock and $4,200,000 common stock, and the cash necessary has been underwritten.

EASTON, PA., RAILWAY.—Messrs. E. H. Gay & Co., Boston, are offering to investors $150,000 Easton, Palmer & Bethlehem Street Railway Co. 5 per cent. 20-year first mortgage gold bonds. The road connects the city of Easton and the borough of Bethlehem, Pa., and passes through several villages in Easton, Palmer and Bethlehem townships. It operates under a perpetual charter about 11⅝ miles of track, seven of which run over its own private right of way, and has acquired about ten acres of land on its line of road which will be converted into an attractive park. The construction of the road is substantial ,and its cars of the modern vestibule type. The management estimates conservatively that the gross earnings for the first year will amount to $55,000; operating expenses, $30,250; net earnings, $24,750; interest charges, $10,000, leaving a surplus of $14,750. The capital stock of the road is $100,000 common and $100,000 preferred, and there are $200,000 bonds.

CONSOLIDATED GAS.—The New York Sun has the following: "The announcement is made that the Consolidated Gas Company had bought the United Electric Light, Heat and Power Company, a Westinghouse property that was recently reported to have been sold to the Third Avenue Railroad. This company controls what electric light, heat and power business the Brady-Whitney-Ryan company doesn't control. This is a partial justification of the opinion held by some that the Consolidated Company and its ally, the Mutual Gas Light Company, are fighting not only the New Amsterdam Gas Company, of which Mr. Brady is a director, but his New York Gas and Electric Light, Heat and Power Company. When asked what he thought the Consolidated wanted of an electric light, heat and power company, Mr. Brady smilingly said, "I don't know. I don't see how it can materially help them in a gas war."

THE WEEK IN STOCKS was an interesting and fluctuating one, with a marked downward tendency. There is no question as to the general activity and prosperity of trade, but more new stocks have been created than the market can care for, and hence a sagging off in prices. Such large deals as are afoot in copper, steel, etc., cannot go through without slowing down the general financial movement, and each new industrial combine makes the banks more chary and conservative. During the week in Wall street 18,251 shares of Western Union were sold, the price running off to 91½. Of General Electric only 2,530 shares exchanged hands, declining to 118. On sales of 66,076 shares, Metropolitan Street Railway sold down to 235 and on 185,935 shares, Manhattan Elevated declined to 114. In Boston, American Bell Telephone closed the week at 365 bid; Erie, 91 asked; New England, 145 bid, and Michigan, 98 bid. West End Railroad was firm at 94¼. Amongst the outside securities in New York City, Electric Vehicle pref. went off to 125 bid and common to 116 bid. Electric Boat pref. was quoted at 51 bid and common at 31.

STREET RAILWAY CONSOLIDATION IN MASSACHUSETTS.—Plans are maturing for the consolidation of the electric street railways in Eastern Massachusetts. The consolidation will take in all the roads south and north of Boston from the northern boundary of Massachusetts to the extreme southern point of Rhode Island, in number about twenty-five, but the consolidation will not include the roads west of Boston connecting that city with Worcester. The consolidated capitalization will be based on the actual cost of the properties, with sufficient additional to provide for the retirement of the floating debts of the roads taken in, and any improvements that may be needed as shown by the expert's report. The proposed issue of stock is divided into 4 per cent. cumulative preferred and common stock and the underwriting has been largely oversubscribed. The stock has been taken largely by the persons interested in the properties consolidated. There will be no bonds and the stock is free from taxes under Massachusetts laws. The syndicate which has secured control of the above properties is represented by Messrs. E. Rollins Morse & Bro. and Tucker, Anthony & Co.

THE COMING AUTOMOBILISM.—Discussing the rapid growth of the automobile industry, a Boston paper says: "Such has been the success of the parent company that in the first two months of this year it was able to pay its full year's dividend of 8 per cent. on the preferred and a dividend of 2 per cent. on the common stock. After the common stock receives in all 8 per cent., both stocks share alike in dividends. The preferred sells at about 140, and the common at about 150. What a transformation from less than two years ago, when the public failed to take more than $1,400 of Kessler & Co.'s offering of the Electric Vehicle Co. A $10,000 subscription in the underwriting at that time would, if followed through, have permitted an investment of $40,000 cash in preferred stock, worth to-day nearly $60,000, together with a bonus of two and a half times that amount of preferred stock, or a bonus of $100,000 in common stock, worth to-day $150,000, or a total profit at to-day's market price of $170,000 upon an original $10,000 investment. Now there has been substantially pledged for the development of the electric vehicle in this country at least $150,000,000, all springing from this parent company, and the managers estimate that 20 per cent. or $30,000,000 can be earned from the Electric Vehicle companies by use of this capital."

THE STATE OF BUSINESS.—Bradstreet's review of the state of trade says: "That this is, indeed, an era of trade and industrial combinations seems evident from the long list of announcements of new consolidations, rumored or actually floated, coming to public view this week. Whether this tendency has as yet reached its culmination cannot, of course, be easily predicted, but in some lines of industry the announcement of projected consolidations would seem to have left little room for further operations of this kind. Easily first in this direction is the gigantic iron and steel combination, announced with seeming confidence as in process of formation. Second only to this, however, is the actual floating of the great copper combination, whose issue of stock, $75,000,000, is reported to have been oversubscribed six times, while the long list of combinations in other lines would, if all of them were carried out, make the week notable in a year memorable for the floating of such enterprises. Outgrowths as these great combinations are of immense industrial changes in many lines, they possess a special interest in the world of trade and finance because of the immense aggregations of capital or industry involved in their projection or their carrying out to a successful finish. The volume of current clearings points to the share taken by financial interests in these great enterprises, because the volume of trade, though at a maximum for this period of the year, will not alone explain the heavy gains over preceding years. Features of this are found in record-breaking totals of daily clearings at the metropolis and at many other cities, and the record for April points to heavier average daily clearings than were reported even in the month of March, which holds the record for heavy aggregate bank clearings. These for the month of April show a gain of 66 per cent. over last year, while for the first week of May they aggregate $2,162,918,000, a gain of 19 per cent. over last week, of 84 per cent. over last year, of 93 per cent. over 1897, of respectively 81 and 92 per cent. over 1896 and 1895, and of 57 per cent. over 1893. Business failures are down to their lowest level, numbering only 164 this week, against 184 in this week a year ago, 240 in 1898, 228 in 1897, 267 in 1896, and 224 in 1895."

Special Correspondence.

NEW YORK NOTES

MR. CHARLES J. GOLDMARK, consulting electrical and mechanical engineer, has removed his office to 29 Broadway, Rooms 268-270.

MESSRS. TOWNSEND AND DECKER, the attorneys-at-law and patent solicitors, have moved their offices to the Washington Life Building, 141 Broadway, where they have secured a nice suite of offices for the conduct of their large practice.

CHEAP CAB SERVICE.—A company has been organized in this city, with headquarters at 100 Broadway, for the purpose of establishing cab services in this city, Buffalo and other cities in the State. The company will, as soon as possible, introduce a system of automobiles in the shopping district. Some of the cabs will, for 25 cents, carry one or more persons anywhere within the boundaries of the district, which will extend north to Fifty-ninth Street. The

charter of the company provides that a charge of not more than 25 cents per mile per passenger shall be made.

THE LAW FIRM OF CRAVATH & HOUSTON, New York, has been dissolved, Mr. P .D. Cravath having become a member of the firm of Seward, Guthrie & Steele, 40 Wall Street, and Mr. Houston's office address will be 40 Wall Street. This firm was well known to all connected with the legal and financial end of large electrical enterprises owing to its close association with Mr. George Westinghouse and the large amount of legal, corporation and reconstruction work, etc., which it carried out for the Westinghouse companies. Mr. Cravath was a member of the board which was appointed to take charge of the exchange of patents between the General Electric and the Westinghouse companies.

REPORTED ELECTRICAL DEAL.—In connection with the gas rate war in this city during the past week, it was stated that the Consolidated Gas Company has bought a controlling interest in the United Electric Light & Power Company. The report, however, was denied at the office of the Consolidated Company, though it is generally believed that the deal has been made. New Yorkers at the present time are enjoying a privilege that is rarely attained; they are getting their illuminating and cooking gas at 50 cents per 1000 cubic feet. This low figure is due to competition between opposing companies, but there are already signs of harmonizing the conflicting interests. In that event the days of 50-cent gas will probably be ended.

MESSRS. BOERNER & LOEWENTHAL is the style of a new engineering firm that has been formed by Mr. Emile C. Boerner, Jr., E. E., and Mr. Max Loewenthal, E. E., with headquarters at 120 Liberty street. They will undertake the full range of engineering work in mechanical and engineering lines from the first design or description up to the finished apparatus or plant or the test upon it. Mr. Boerner was a graduate of the Columbia University School of Engineering in 1897 with degree of E. E., and is the son of the mechanical superintendent of the well known Portchester Bolt & Nut Co. He has been actively engaged for some time, especially in the testing department of the Solvay Process Co. at Syracuse. Mr. Max Loewenthal is another Columbia E. E., and was at one time on the editorial staff of The Electrical Engineer. He has also had a good deal of work in the practical field, and is a hard worker and persistent student of progress. The new firm may be commended to all who may require their services in the various departments for which they offer themselves.

NEW ENGLAND NOTES.

MESSRS. ALBERT & J. M. ANDERSON, Boston, have found their business increasing so rapidly during the past year that it has become imperative to have more space, and they are now adding four stories to their existing factory in South Boston. Business is better with them than in years past.

THE CROSBY STEAM GAGE & VALVE COMPANY, Boston, is calling attention to a novelty in the shape of spring-seat globe and angle valves that do not leak. The working parts of these valves are all renewable without removal of the valve from the piping, and all the parts are interchangeable. All the valves are tested under a hydraulic pressure of more than 400 pounds, and are guaranteed not to leak at high pressures.

THE B. F. STURTEVANT COMPANY, whose well known "chimneyless" factory is situated at Jamaica Plains, near Boston, is making an addition to its already large floor space, for electrical work. Another story is being added to two of its shops, one 125 by 50 feet and the other 100 feet square, both of which will be used for this purpose. The increase in this department has been enormous. The company is now making electric motors up to 125-hp and generators up to 100-kw.

THE PETTINGELL ANDREWS COMPANY, Boston, who is the sole New New England agent for Lundell fan motors, is making at present a very handsome display of these popular devices for making summer days bearable. It has on exhibition in its store on Winthrop Square samples of all the most recent Lundell models, both of the desk and ceiling types, and as many of them are in continuous operation, it makes the store a comfortable resting place and a cool spot in which to transact business, which appears to be rushing at present with this progressive house.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—At the last meeting of the Society of Arts of the Massachusetts Institute of Technology on April 27, Mr. T. B. Kinraide, of the Spring Park Laboratory, Jamaica Plain, Mass., presented an unique form of induction coil of great power invented by him. This has been especially applied to the study of discharges by the aid of photographic processes, the plate being balanced on the point of discharge in a dark room and being developed after exposure. It reveals in a striking manner the marked difference that exists between the positive and negative discharges. The apparatus was exhibited in operation and photographic plates shown with the lantern.

ANNUAL OYSTER ROAST OF THE BERLIN IRON BRIDGE COMPANY.—Each year the Berlin Iron Bridge Company, of East Berlin, Conn., gives a reception and an oyster roast to its employees and friends. The fourth annual roast took place on the night of April 26, and no less than 2000 guests were present. President Charles M. Jarvis always takes great interest in the event, and he and his associates spend as much time in planning for its success as they do for a giant steel bridge. The shops were closed at noon on the 26th, in order to prepare for the feast. Thirty thousand oysters were sacrificed. The employees and their families were entertained during the afternoon and the evening train brought crowds of the invited guests. The Berlin Iron Bridge Company's band furnished music, and the template department, which had been cleared, was turned into a ballroom where dancing was indulged in. The company's new shop was used as a dining room. The entire plant, from the president's private office to every corner of the establishment, was thrown open to the freedom of all. The affair was very successful.

PHILADELPHIA NOTE.

ELECTRIC LIGHT COMPANIES EXEMPT FROM PAYING TAXES.—In the case of the Southern Electric Light Company of this city, the Supreme Court has rendered a decision to the effect that companies generating and supplying electric current for lighting purposes are not subject to municipal taxation of their real estate and plant. The Southern Company owns two properties, one of which has not been in use for some years, while the other was in active operation. The company claims that the old plant was necessary in its business for temporary use in case of a breakdown. The city claimed that neither plant was entitled to exemption because both were used only for the manufacture of electricity and the process of manufacture was not public in its nature, but only that of supplying. The court decided that the old plant was still for public use, if it was waiting for public use, and that supplying of electricity implied its manufacture. Under this decision all the electric light companies now operating in the city are thought to be exempt from taxation.

WESTERN NEW YORK NOTES.

MR. W. K. DUNLAP, the Niagara Falls representative of the Westinghouse Electric & Manufacturing Company, has returned from an extended European trip, much improved in health.

PERSONAL.—H. A. Thomas, of Niagara Falls, has been engaged by the Deep Leads Electric Transmission Company, Limited, of London, England, to superintend the erection of a power plant in the gold fields near Melbourne, Australia.

STRIKE OF ELECTRICAL WORKERS.—The union electrical workers of Buffalo, numbering between 100 and 200, have struck, making a demand for $3 a day instead of $2.50. The strike affects most of the large concerns, but they claim they can get along, while the strikers assert that they can get enough work elsewhere to support them.

DR. C. HOYSFUER, of Frankfort-on-the-Main, Germany, is at Niagara Falls inspecting the power development there, with a view to the establishment of a plant for electrolytic production of copper, zinc and other metals. He now has plants of this kind in operation in England, Germany and Austria, and the men interested are seeking a location for a site for a plant in the United States.

NEW ELECTRIC RAILWAY.—The Board of Trade of Batavia has interested itself in a proposed new electric road from Batavia to the shore of Lake Ontario. It is said a great fruit district will be opened up. The scheme calls for a passenger and freight line, touching at Oakfield, Wheatville, Alabama, Shelby and Medina and passing on to Lakeside on Lake Ontario. The projectors talk of using the Waterport power development for operating a portion of the line. Rolison S. Bostwick, of Rochester, is interested.

CLEVELAND NOTES.

THE CLEVELAND CITY RAILWAY COMPANY is experimenting with a new electric headlight, the invention of Mr. George A. Schroeder, of this city. It has a multiplex reflector, the rays of a single incandescent light being multiplied by corrugations in the reflector which give a light of great intensity.

TUSCARAWAS ELECTRIC RAILWAY.—The stockholders of the Tuscarawas Electric Railway Company held their annual meeting in New Philadelphia recently. The following named officers were elected: F. T. Pomeroy, Cleveland, president; J. A. Rutherford, Cleveland, vice-president; William Akers, formerly of Cleveland, will act as superintendent, secretary and treasurer. A branch office of the company will be established in Cleveland. The line is one of the most prosperous in Ohio.

POWER CONSUMED BY SHAFTING AND BELTS.—At a meeting of the Civil Engineers' Club, of Cleveland, Ohio, on April 11, Prof. Charles H. Benjamin read a paper, entitled "The Power Consumed by Shafting and Belts," which was illustrated by lantern slides. The experiments described in the paper were made on the shafting and belts used to drive the machine shop at the Case School of Applied Science, in Cleveland, by the aid of a Flather recording dynamometer. In these experiments the horse-power required to drive the shaft alone was found to be about one-third that required for shafting, belts and loose pulleys.

STREET RAILWAY FRANCHISE IN CLEVELAND.—Messrs. P. B. Kassulker, Charles A. Klump, Omar Stoppel and Louis Pollowskey, all well known business men of this city, have applied to the city council for a franchise to operate a street railway over a route, including a number of leading streets on the East Side. They promise better service and lower fares than those given by the two lines which now control the roads in this city. However, people who are closely in touch with existing conditions say there is little possibility of another line securing a footing in Cleveland, as the old roads will block the game at any cost.

DANGEROUS SPEED OF TROLLEY CARS.—The Cleveland daily papers and the public in general are up in arms against the rate of speed maintained on the lines of the "Big Consolidated," or Cleveland Electric Railway. Two months ago when Mr. H. A. Everett secured control of the stock in this company he promised the people better service, which promise he carried into effect by cutting down the running time on all lines. The result is the cars are operated at a speed far in excess of the 12 miles per hour allowed by the city ordinances. In consequence of the high speed, especially on the narrower streets, the number of accidents has increased at an alarming rate. These accidents have caused such a storm of protest that the police have been instructed to arrest the crews of cars found to be exceeding the speed limit. Within the past two or three days, six motor men have been arrested for running at a high rate of speed, several cars having exceeded 20 miles an hour.

INDIANA NOTES.

NEW TELEPHONE VENTURE.—On April 28 the Laporte Telephone Company decided to build a telephone line between Laporte, Hanna, Union Mills and Kingsbury, the work to proceed at once. The company has secured the privilege of building the line under authority granted in the old A. J. Stahl franchise, which is yet in force and valid.

ELECTRIC RAILWAY FRANCHISE.—The Morgan County Commissioners granted on May 2 a franchise for an electric railway from Martinsville through the county to the Marion County line to the Indianapolis & Martinsville Electric Railway Company. The company is headed by P. H. Fitzgerald. S. R. Holt, J. C. Tarkington and J. T. Elliott, Jr. The officers say the road will be constructed at once.

TELEPHONE COMPANIES TO CO-OPERATE.—Hon. Simon P. Sheerin, of Indianapolis, representing the New Long Distance Telephone Company, has made a contract with the Home Telephone Company, of Richmond, Ind., which now has a plant nearly completed, by which the two are to co-operate. The new company expects to have its system ready by July 1, the date set for the completion of the local plant.

ELECTRIC VEHICLES.—On April 27 the Indianapolis Transfer Company was incorporated, with a capital stock of $50,000, for the transportation of freight and passengers within the city. The members of the new company are J. E. Morano, W. E. Stevenson, W. F. Churchman and W. H. Worth. The company has purchased a large plant and will add a complete line of horseless vehicles propelled by electricity. The company's officers are: President, J. E. Morano; secretary and treasurer, W. E. Stevenson.

TELEPHONE CONTRACT QUESTIONED.—The Central Union Telephone Company calls into question the validity of the contract between the Board of Public Safety of Indianapolis, and the new telephone company for city service. This contract was for a period of one year. The Central Union Company, by its superintendent, says the contract is illegal, and he asks an opportunity to bid for the service. Members of the Board of Public Safety say all efforts to get a bid from the Central Union failed before the contract with the new company was entered into.

RAILWAY FRANCHISES IN TERRE HAUTE.—On May 2 the County Commissioners signed a franchise granting a 50-year lease to W. S. Stone and C. E. Webster, of Boston, for the National road from Terre Haute to the Clay County line. It is stipulated that cars shall pass a given point every fifty minutes and the fare each way is not to exceed 15 cents and for the round trip of 16 miles to Brazil and back is not to exceed 25 cents. The same parties have asked the Clay County Commissioners for a franchise. The syndicate represented by Messrs. Stone and Webster hold an option on the Russell Harrison street railway property in Terre Haute, which is to be sold by order of court on May 12.

BROAD RIPPLE ROAD SOLD.—The Broad Ripple Rapid Transit Company has changed hands, and all the tangible property of the road between Indianapolis and Broad Ripple passes to new ownership. The purchasers are Boston, New York and Indianapolis people, William H. Schmidt, county treasurer at Indianapolis, becoming president. The consideration is not definitely stated, but said to be small—about $160,000. This is on account of the debts of the company. The new purchase will adjust all claims and operate the road upon an improved plan and with ample capital. The road is now in the hands of J. B. Cockrum, receiver who will turn the same over to Mr. Schmidt, the new president.

THE INDIANAPOLIS STREET RAILWAY COMPANY took possession of the Citizen's Street Railway Company on May 2. The old franchises have been surrendered to the city, and the first payment, $30,000, was made to the city. Purchasers of tickets now have a four-cent fare. Orders have been given for new cars and large sums will be expended on the betterment of the plant. The capital stock is $5,000,000 par. The bonds outstanding, $3,750,000, carry 4 per cent. interest. One million dollars of 4 per cent. bonds are provided to take care of one million of the old mortgage debt of the Citizen's company, which now bears 6 per cent. interest, and $2,250,000 of 4 per cent. bonds are provided for funds for expenditure on the plant.

THE NEW TELEPHONE COMPANY IN INDIANAPOLIS.—The inroads made by the New Telephone Company on the territory and among the subscribers of the Central Union Company is startling. At first the Central Union refused to take out its instruments when the subscriber had switched off to the New Company, but is now complying with such requests when made emphatic. It is not unlikely that a mad rivalry will occur between the two companies soon. Everything seems ripe for such an occurrence. The New Company began regular service to 500 subscribers on May 2 and issued a directory. The company expects to add 120 subscribers daily until all who have made contracts with it are receiving full service. By July 1, Secretary Gates estimates that the company will have nearly 4,000 telephones in use. The plant includes nearly eight miles of conduits and 512,000 feet of duct for cables. There are over 8000 miles of copper wire, and an additional 551 miles of bare aerial wire and 110 miles of insulated wire.

THE NEW TELEPHONE COMPANY, at Indianapolis, has offered for sale through the Union Trust Company, at par, in blocks of $100 to $1000 each, $150,000 of the capital stock (the whole issue being $400,000) to the company's subscribers for telephones. The stock is guaranteed by the Union Trust Company to yield 6 per cent. annual dividend for five years, 3 per cent. semi-annually, payable in January and July each year. The stock is to be paid for in instalments, and will be non-taxable, as all taxes on the property will be paid by the corporation. The officers and stockholders insist that the sole purpose in offering this stock is to bring the company still nearer to the people, and the more its stock is scattered among the citizens of Indianapolis the more certain it will be to retain its popularity. The remaining $250,000 of stock has been placed by its owners in the hands of the Union Trust Company, to be held under a written agreement with the Trust Company, and each stockholder with all the others, which absolutely prohibits the sale of the stock for five years. The declared purpose of the agreement is to insure the continuance of the company as a competitive organization and to prevent a majority of the stock from getting into the hands of people whose interests are opposed to the avowed aims and purposes of the company. The company, it is stated, now has 3500 subscribers.

CHICAGO NOTES.

MR. G. G. LUTHY, general manager of the Royal Electric Company, Peoria, Ill., spent a few days in Chicago last week.

MR. S. FUGITA, superintendent of the Tokyo City Street Railway Company, Tokyo, Japan, is at the Auditorium Hotel in this city. He is in this country to investigate the practicability of compressed air as a motive power for street railways.

EXTENDING THE ELECTRIC LIGHT SERVICE.—Work has been commenced in putting up between 40 and 50 miles of electric light wire for the installation of 500 new arc lights on the North Side of the city. The power for these new lights will be taken from the new station at Rice and Lincoln Streets.

ARC LIGHT SWITCHBOARD FOR OTTAWA, ONT.—The Western Electric Company, Chicago, has constructed an extensive arc light switchboard for the Ottawa Electric Company, Ottawa, Ontario. The board is built of marble panels and mounted in an iron frame. It is designed for 24 circuits and 24 dynamos.

THE FARR TELEPHONE & CONSTRUCTION COMPANY denies the statement recently made in the Chicago papers that it had been defrauded out of $14,000 by a man representing himself as the warden of the Kingston (Ont.) penitentiary. Such a man did call upon the company and endeavored to obtain goods, but failed in his object. He is under arrest.

THE AUTOMOBILE DEAL.—The Illinois organization of the Electric Automobile Company, recently formed by W. C. Whitney and other Eastern traction capitalists, has been practically completed. The company in this state will bear the title of the Illinois Electric Vehicle & Transportation Company. According to the plans it will build and operate electric automobiles in Chicago and throughout the state and the West generally. A large plant will be established in this city where the general offices will be located.

MESSRS. SCHUREMAN & HAYDEN, Chicago, on May 1, moved their office and factory to 139 South Clinton Street, between Adams and Monroe Streets. The constant increase in the firm's business made it necessary to seek larger quarters and in its new location, with increased facilities and space, the firm will be able to handle large size machinery with minimum expense. Messrs. Schureman & Hayden are general dealers in electrical machinery and do a large dynamo and motor repairing business. They carry a stock of first class secondhand motors and dynamos.

A NEW ELEVATED RAILWAY SYSTEM.—An elevated railway ordinance was introduced in the City Council empowering the Chicago Western Elevated Railway Company to construct and operate an elevated railway for a period of 20 years, the city to receive 5 per cent. of the gross receipts for the first three years and 10 per cent. for the remainder of the term. Provision is made for municipal ownership at the end of 10 years. The construction of the proposed plant is novel. The car is suspended on a single track and operated by electric power, the track being supported by a single line of iron posts.

LONG-DISTANCE TELEGRAPHY.—The Associated Press, which operates a complete system of wires leased from the Western Union Telegraph Company, combined its circuits the other day, forming a line of 6,000 miles in length. The circuit reached from New York City to the Pacific Coast and from Chicago to New Orleans, touching Philadelphia, Pittsburg, Cincinnati, Atlanta, Memphis, St. Louis, Kansas City, Omaha, Denver, San Francisco and other intermediate points south and west. The circuit was worked for several hours, and was manned by 41 operators in all, who received the matter transmitted from New York. Newspapers in 38 of the leading cities of the United States are served directly by the Associated Press telegraph service.

ST. LOUIS NOTES.

INCREASING THE WAGNER COMPANY'S CAPITAL.—The Wagner Electric Manufacturing Company filed articles to increase its capital stock from $250,000 to $500,000. Its assets are $481,830.55, and liabilities, $126,130.61. Three-fourths of the increased capital is paid in.

ELECTRIC POWER IN A SHOE FACTORY.—The Hamilton-Brown Shoe Company, St. Louis, has decided to operate by electric power the machinery in its new factory, now being built. A complete plant with modern appliances has been purchased and will soon be placed in position.

RECEIVER FOR A LITTLE ROCK, ARK., CONCERN.—A telegram from Little Rock states that Chancellor T. B. Martin, upon the application of foreign creditors, has placed the Brown Electric & Machinery Company in the hands of Charles M. Connor as receiver. Liabilities, $11,000; estimated assets, $4500. W. G. Brown was the principal owner of the plant.

STREET RAILWAY LEGISLATION IN MISSOURI.—A bill revising the street railway laws was engrossed by the State Senate on May 1. The most important feature of the bill provides that street railway companies shall have the right to purchase, lease or acquire the capital stock and bonds of other street railway companies, and to hold and dispose of the same, when approved by a vote of two-thirds of the stockholders. This provision enables street railway companies to consolidate.

ANNUAL MEETING OF THE MISSOURI RAILWAY.—The stockholders of the Missouri Railway Company, comprising the Olive Street, Laclede avenue and Market Street lines, held their annual meeting May 8 and elected Edwards Whitaker, Charles D. McLure, J. C. Van Blarcom, C. C. Moffitt and Ephron Catlin directors for the ensuing year. It is understood that plans for

the consolidation of the Lindell, Missouri and Union Depot system and the Central Traction Company have been practically completed by Brown Bros. & Co.

PERSONAL.—Mr. Richard McCulloch has resigned his position as electrical engineer of the Spencer and Orthwein lines, to become general manager of the Compagnie des Tramway Suisse, at Geneva, Switzerland. The horse tramways at Geneva have recently been purchased by an English syndicate and will be converted into electrical lines. Mr. McCulloch will be master of construction and will manage the system when it is completed.

THE NATIONAL TELEPHONE COMPANY, of St. Louis, is arranging to install a model plant in Belleville, Ill. The exchange equipment will include a new multiple, gravity drop switchboard. A company has been organized in Belleville, with a capital stock of $20,000, one-half of which has been taken by prominent business men. The company has secured 300 five-year contracts, and will connect withthe Kinloch system to St. Louis. The National Company is now managed by Mr. W. J. Kurtz, and has a large factory at 1726 Glasgow Avenue in this city.

TEXAS AND MEXICO NOTES.

ELECTRIC LIGHT IN MONTEREY.—The electric light company of Monterey, Mexico, has just received two large boilers and two new dynamos. It is the intention of the company to inaugurate a day service. The boilers are said to be the largest ever shipped to Mexico. They were purchased in the United States.

WATER POWER IN MEXICO.—The work of constructing large reservoirs at Ajusco, near the City of Mexico, in which water from the neighboring mountains will be stored, is making good progress. The water will be used to operate an electric power plant. It is proposed to erect a number of factories in the neighborhood of Ajusco.

A PROGRESSIVE MEXICAN TOWN.—The inhabitants of Ciudad Guzman, state of Jalisco, Mexico, have raised by popular subscription $20,000 of the $32,000 needed for the installation of an electric light plant in that town, and expect to raise the balance very soon. Ciudad Guzman is having a rapid growth and the business men of the place are showing a progressive spirit in the matter of making public improvements.

ELECTRIC LIGHT IN THE TARPON FISHING CLUB HOUSE.—The magnificent new club house of the Tarpon Fishing Club, recently erected on Mustang Island, just off the coast of Texas, near Rockport, has been equipped with an electric lighting plant. This club is one of the most noted fishing clubs in the United States, and embraces among its membership such distinguished men as President William McKinley, ex-President Grover Cleveland, Hon. Thomas B. Reed and many others.

THE TEXAS ANTI-TRUST LAW.—The quo warranto cases of the state of Texas against the San Antonio Street Railway Company, the Mutual Electric Company and the Edison Street Railway Company, for forfeiture of their charters and appointments of receivers for violation of the Texas anti-trust law in entering into a combine to control prices, etc., have been postponed until a decision of the higher court is reached in the case of similar nature against the San Antonio Gas Company, which was recently found guilty in the district court of being a party to the alleged combine.

CANADIAN NOTES.

THE CANADIAN ELECTRICAL ASSOCIATION.—The next annual convention of the Canadian Electrical Association will be held in Hamilton, Ont., on June 28, 29 and 30. The business sessions, as well as the banquet, will probably be held in the new Royal Hotel. A sufficient number of papers on a variety of subjects of interest to those engaged in the various departments of electrical work have been promised, and are in course of preparation. Among the features of entertainment will probably be a trip to the beach over the Hamilton Radial Railway and an evening excursion on the lake; a trip to Grimsby Park over the Hamilton, Grimsby & Beamsville Electric Railway, and a visit of inspection to the stations of the Cataract Power Company at St. Catharines and Hamilton.

THE OTTAWA ELECTRIC COMPANY has made a proposal to the city council of Ottawa, Ont., to dispose of its lighting plant to the city. Many of the city aldermen are in favor of the city operating its own electric light plant. The nature of the proposition, so far as can be learned, is that the company offers to dispose of its plant, good will, business and perpetual franchise to the city at par; or, in other words, that the corporation take the entire stock at par value. The stock amounts to nearly $1,000,000. The Electric Company agrees to hold its offer open for 12 months from May 1, 1899, on the express condition that the city shall not grant, in the meantime, an extension to the franchise of any existing competing company, and shall not issue a franchise to any outside company. The Metropolitan Electric Company is seeking a 20 years' extension.

General News.

THE TELEGRAPH AND TELEPHONE.

FAULKTON, S. D.—The Dakota Central Telephone Company is building a line from Redfield to Faulkton.

BRIMFIELD, ILL.—The Brimfield Telephone Company has been organized, with a capital stock of $500,000, by Addison Pacey, J. H. Casson and C. L. Dungan.

LESLIE, MICH.—The City Council has granted a 30-year franchise for a telephone exchange in this place.

HARTLEY, IOWA.—At a recent election in this place it was voted to grant a franchise for a local telephone exchange.

ARKANSAS CITY, KAN.—A telephone company has been incorporated here, with a capital stock of $10,000, under the name of the Indian Telephone Company.

DENTON, MD.—The Bee Line Telephone Company, of Caroline County, has been organized here and will begin at once the work of establishing a system in Denton.

TRENTON, N. J.—The Scranton Telephone Company has been incorporated, with a capital stock of $300,000, by William C. Hendrickson, Edward Barneman and Jesse G. House.

FRANKFORT, KY.—The Frankfort Telephone Company has been incorporated by Messrs. W. W. Longmoor and R. V. Bishop. The capital stock of the company is $10,000.

CHICAGO, ILL.—The American Independent Telephone Company has been organized in this city, with a capital stock of $2500. The incorporators are George H. Wilder, Albert Martin, George H. Taylor.

PRINCETON, MO.—It is stated that the promoters of the new telephone company of this city have sold all their material to the Bell Company and have given up the idea of putting in a new system here.

AKRON, OHIO.—The People's Telephone Company, of this city, has been organized, with a capital stock of $150,000. The incorporators are Will Christy, J. R. Nutt, John P. Loomis and R. S. Iredell, all of Akron.

NEW PAYNESVILLE, MINN.—The Minnesota Central Telephone Company has combined with the Western-Stearns Telephone Company, and will at once construct lines from this place to Lake Henry and Spring Hill.

GUTHRIE, OKLA.—A 99-year charter has been granted to the Oklahoma & Kansas Telephone Company, which will have its principal office at Medford. The directors are John W. Pyle, Frank L. Pyle and W. B. Ingram.

ALBION, MICH.—The People's Telephone Company, of Albion, with a capital stock of $15,000, has been organized by A. J. Little, Battle Creek; F. L. Irwin, L. S. Warren, M. O. Shepard, Newman Miller, all of Albion.

SALUDA, S. C.—The Saluda Telephone Company has been organized, with a capital stock of $400, by Alvin Ethridge, J. J. Kirksey, B. W. Crouch, P. J. Coleman, B. F. Ethridge, all of Saluda, and A. L. Coleman, of Higgins.

DETROIT, MICH.—The Michigan Telephone Company will soon construct a line to connect the St. Clair Flats with the company's system. Several thousand feet of submarine cable will be necessary to carry out the improvements.

DENVER, COLO.—The Colorado District Telegraph Company has been incorporated here to operate a line in Lake, Pueblo, Fremont, Las Animas, El Paso, Teller, Boulder and Arapahoe counties. The capital stock of the company is $100,000.

FULTON CHAIN, N. Y.—The Webb Telephone & Telegraph Company has been incorporated, with a capital stock of $10,000. The incorporators are Francis E. Schaick, Dennis Moynihan and Charles A. Van Auken, C. Wallace and Henry Edick, Jr.

KIRKSVILLE, MO.—The Kirksville Telephone Company has been organized in this place, with a capital stock of $14,000. The names of the incorporators are J. M. Kennedy, J. C. Storm, S. M. Link, H. C. McCahan, V. Miller, Charles E. Still, all of Kirksville.

FAIRMOUNT, MINN.—The Fairmount Telephone Company is extending its system and covering territory south and west. An extension is being carried to Armstrong, Iowa, and the company will build lines along the new railway of the Omaha, Minneapolis & St. Louis road.

WARREN, OHIO.—A deal has been made between the United States Telephone Company, of Cleveland, and the Warren & Niles Telephone Company, by which the two systems will be connected. It is expected that the line between Youngstown and Cleveland will be in operation in 60 days.

CIRCLEVILLE, OHIO.—A new telephone company has been organized in this city under the name of the Circleville Telephone Company, by Messrs. Charles E. Groce, William T. Bell, B. F. Benford, John L. Kimmel, F. M. Shulze, all of Circleville. The capital stock of the company is $10,000.

STOCKPORT, OHIO.—A telephone line will be constructed from Chester Hill to McConnelsville by the Morgan County Telephone Company, which has just been organized in this place, with a capital stock of $10,000. The names of the incorporators are C. H. Foutz, T. J. Lyne, W. H. Broomhall, T. J. Mercer, E. S. Pierrot, all of Stockport.

NEWFIELD, N. Y.—The Trumbull Corners' Telephone Company, of Newfield, has been organized to connect the villages of Newfield and Trumbull by telephone. The capital stock of the company is $300, and the incorporators are J. D. Smith, Wheeler Smith, William L. Puff, George A. Kresga, J. C. Everhart, W. A. Smith, A. S. Knight.

MILWAUKEE, WIS.—General Manager Charles Webster, of the Western Electric Telephone system, was in this city recently for the purpose of making an effort to establish and operate a telephone system here. It is the intention, he says, to extend the lines to important towns and cities in the State, and offer telephone service at very low rates.

ST. PAUL, MINN.—The Board of Aldermen has granted a local and long-distance telephone franchise to the American Telegraph & Telephone Company. The term of the franchise is for 25 years. No poles or wires are to be placed above the ground in the business portion of the city. The city is given the right to use the conduits and poles of the company, and a 3 per cent. tax on the gross earnings will be imposed upon all local business.

WYTHEVILLE, VA.—The Pulaski City Telephone Company has been granted permission to establish a telephone system in this place. The Pulaski Company now owns charters in Radford, Dublin, Pulaski City, Wytheville and Marion, and it is the intention to extend lines to Roanoke City on the east and Bristol on the west. When the improvements are completed the system will be one of the best in Virginia, and will have 150 miles of line.

NEW YORK, N. Y.—The Seaboard Telegraph & Telephone Company has ben organized to establish a telephone system on Long Island. The capital stock of the company is $100,000, and the directors, who are all residents of Long Island, are Dr. J. Carl Schmuck, of Lawrence; Andrew McTigue, L. T. Walter, Jr., and B. C. Lockwood, of Far Rockaway; John Adikes, of Jamaica, and Samuel R. Smith and George Christians, of Freeport. The company proposes to construct a line from Far Rockaway to Montauk on the south side, thence to Orient and Riverhead on the north side, taking in all places to Brooklyn.

ELECTRIC LIGHT AND POWER.

BEREA, OHIO.—A recent vote was taken on the question of issuing $12,000 for electric bonds, and the proposition was carried.

DANVILLE, PA.—The voters of this place at a recent election decided to increase the indebtedness of the town $15,000 to establish an electric light plant.

HAVANA, CUBA.—The contract for the electric lighting of Havana has been given to Messrs. DuBois & Boulanger, who will construct an $80,000 plant.

ALBANY, N. Y.—The Kinderhook Light & Power Company and the Citizens' Electric Light & Power Company have been merged into the Hudson Light & Power Company.

AUGUSTA, GA.—A syndicate of New York and Georgia capitalists is investigating the water power at Kilchrist, 40 miles above this city, with a view of establishing a power station there.

WYANDOTTE, MICH.—The proposition to bond the city in $12,000, $8000 of which was to be devoted to the purchase of the Doyle electric light plant, was defeated by the voters recently.

DUNKIRK, N. Y.—Mr. Gerald E. Mix, of this city, and H. F. King, of Corry, Pa., have been granted a franchise to establish and maintain an electric light plant in the village of Falconer.

HARTSVILLE, S. C.—Application for a charter has been made by the Hartsville Electric & Water Company. The capital stock is $2000, and the incorporators are James L. Coker, Jr., and J. J. Lawton.

CEDAR RAPIDS, IOWA.—The Cedar Rapids Electric Light & Power Company is making an addition to its plant. It has placed orders for an 8000-light dynamo, and two 1000-hp tandem-compound engines.

MANKATO, MINN.—The Mankato Electric Street Railway, Light & Power Company has been organized, with a capital stock of $100,000. Messrs. Davies and Wilhartz, of this place, are interested in the enterprise.

RALEIGH, N. C.—It is reported that the North Carolina Power Company, which will develop the power of the Yadkin River as a part of its plan, will invest $500,000 in a modern cotton mill, to be operated entirely by electric power.

ELIZABETH, N. J.—The Essex Union Water & Light Company has been incorporated, with a capital stock of $500,000. The incorporators are Carroll P. Barrett and Frederick Green, of Summit, N. J., and Frederick R. Drake, of Easton.

HATTIESBURG, LA.—A charter has been granted to the Hattiesburg Electric Light & Manufacturing Company. The capital stock is $50,000, and the incorporators are William Dunbar, W. W. Bostick, the Hattiesburg Lumber Company and others.

JERSEY CITY, N. J.—An unlimited franchise was granted by the Union Hill Council to the North River Heat, Light & Power Company. No compensation was exacted for the franchise. The company is making an effort to obtain a franchise in Weehawken.

SOUTH BETHLEHEM, PA.—The South Bethlehem Electric Light Company has been organized, with a capital stock of $30,000, by Charles P. Hoffman, William H. Lauer, M. J. McBride, Robert Felker, Cyrus Jacoby, C. M. Finaday, all of South Bethlehem.

GRAND RAPIDS, MICH.—The Twin City Electric Company, recently organized here, with a capital stock of $20.000, will immediately begin the erection of a plant for the purpose of furnishing light and power. The enterprise is backed entirely by home capital.

MONTREAL, QUE.—The directors of the Standard Light & Power Company at a recent meeting ordered the payment of a semi-annual dividend at the rate of 8 per cent. per annum. This company is supplied with current from the Lachine Rapids power plant.

CAMDEN, N. J.—The Camden Lighting & Heating Company has been absorbed by the Electric Company of America. Judge Armstrong, who was president of the Camden Company, has been succeeded by the Hon. Loudon Snowden, ex-Postmaster of Philadelphia.

CARTHAGE, MO.—The G. Jaeger Electrical Company, of Rich Hill, has been awarded the contract to build the municipal light and power plant for this city. The contract price for the work is $25,125. Legal steps are being taken to prevent the city from going into the private lighting business.

KALAMAZOO, MICH.—The Kalamazoo Valley Electric Company has offered to furnish current for the city street lamps for $2 a month for all-night lamps. The company is building a dam across the Kalamazoo River, which will furnish 3000-hp. A transmission line is now being built from the power house to the city.

CONNELLSVILLE, PA.—A charter has been granted to the Youghiogheny Light, Heat & Power Company, of this city. The capital stock of the company is $15,000, and the directors are George J. Humbert, Samuel K. Slaymaker, Joseph Soisson, Joseph D. Madigan, John F. Soisson and William A. Davidson, all of Connellsville.

NEWPORT, R. I.—It is stated on apparently good authority that the Newport Illuminating Company and street railway have been sold to the Shaw-Morgan syndicate, which controls practically all the electric roads in this section of New England. The Newport Illuminating Company's stock is held principally by cottagers, the largest stockholders being H. O. Havemeyer, Jr., Cornelius Vanderbilt and others.

TRENTON, N. J.—The United Power & Transportation Company has been incorporated here, with a capital stock of $12,500,000. Among the objects of the company is the furnishing of electric power. The incorporators named are employees of the New Jersey Corporation, Guaranty & Trust Company. The company has been incorporated for the purpose of merging the Reading & Lebanon, Chestnut Hill & Roxborough electric railways.

DECATUR, ALA.—The Decatur Light & Power Company has been reorganized and has purchased the plant of the electric light company. It will operate the electric plant and the old gas plant under one management. The two concerns represent an investment of $100,000. Extensive improvements are contemplated. Mr. T. H. Harris, former manager of the electric light company, will probably be manager of the new company.

ALBION, N. Y.—The Albion Power Company has let the contract for the construction of a 20-foot dam at Waterport and the electric line from that point to this city. Mr. W. L. Adams, of Niagara Falls, has secured the contract to build the power station and the transmission line. It is expected to have the plant in operation by July 1. The power house of the old Albion Electric Light Company will be converted into a transforming station.

SCRANTON, PA.—The West Side Electric Light, Heat & Power Company has applied for a charter to supply light, heat and power in West Scranton. The plant will be on Keyser Creek and a large dam will be built at the site to furnish water power for the machinery. A steam power plant will also be installed in order to supply power for the operation of the plant in the event of low water. The capital stock of the company is $20,000, and the incorporators are Fred Warnke, Jacob Warnke, M. F. Sands, C. A. Yoos and John M. Corbett, all of Scranton.

LIVERMORE FALLS, ME.—The Livermore Falls Electric Light & Power Company has elected the following named officers: President, Edwin Riley; treasurer and clerk, John H. Maxwell. The capital stock of the company is $100,000. The company will utilize some of the power of Rockomeka Falls in the Androscoggin River at Livermore Falls, and will immediately install a 1000-light dynamo. The company proposes to furnish power to industrial establishments and for electric light, both public and private. It is expected that the plant will be in operation within a month.

OTTAWA, ILL.—The report of the superintendent of city lights for the year ending April 1, shows that the cost of maintaining 136 lamps during the year, including insurance, salaries, 5 per cent. on money invested and 5 per cent. depreciation, was $48.75 per lamp. This is not a municipal plant in the strict sense of the word. The dynamos and circuits belong to the city, which maintains the circuits, carbons the lamps and repairs the dynamos. The Thomas Electric Light & Power Company furnishes the power and attendance of dynamos at the station and waste oil. The lamps are 2000-cp and run all night and every night.

THE ELECTRIC RAILWAY.

PHILADELPHIA, PA.—The Carbon County Electric Railway Company has secured the right of way through Bloomingdale Valley and will extend its line to Summit Hill.

MEDIA, PA.—The Council of Yeadon Borough has granted a franchise to the Midland Street Railway Company to lay tracks and operate a trolley road on certain streets of the town.

SPRINGFIELD, OHIO.—The National Traction Company has secured the right of way through Franklin, Madison, Miami and Clark Counties for an electric railway between Columbus and Indianapolis.

SCRANTON, PA.—It is reported that the Scranton Railway Company, which is owned by D. W. Clark & Co., of Philadelphia, has been sold to the syndicate which purchased the Wyoming Valley Traction Company.

BOSTON, MASS.—A bill has been introduced in the Senate to incorporate the purchasers of the Newburyport & Amesbury street railway as the Citizens' Electric Street Railway Company, with a capital stock of $190,000.

BENTON HARBOR, MICH.—The City Council has granted a new franchise to the Benton Harbor & Eastern Spring electric street railway. The road is to be completed in 60 days, and will run in connection with the lines already established in the two cities.

PEEKSKILL, N. Y.—The Peekskill Traction Company has organized by the election of Frank Frye, president; Charles Mason, vice-president; J. L. Jarvis, treasurer, and Jacob Lorch, secretary. The company expects to have the road in operation by December next.

NASHVILLE, TENN.—The Nashville Railway which succeeds the Nashville Street Railway Company, has been incorporated, with a capital stock of $6,500,000. The names of the incorporators are E. C. Lewis, A. H. Robinson, W. M. Hunt, J. C. Bradford and W. H. Bruce, all of Nashville.

TROY, N. Y.—It is practically certain that the Lake Dunmore, Brandon & Rutland electric railway will be constructed. The estimated cost is $300,000. The road will be about 25 miles in length, and the route will be from Lake Dunmore at the cascade to Brandon and through other places to Rutland.

TRENTON, N. J.—The American Railways Company, with an authorized capital of $25,000,000, has been incorporated here. The company is empowered to build, construct and operate electric and other railways. The incorporators are Frank R. Hansell, George B. Martin and William F. Eidell, all of Camden.

WHITE PLAINS, N. Y.—The Third Avenue Railway Company has taken formal possession of the Tarrytown, White Plains & Mamaroneck trolley system. A new board of directors was chosen, with Edward A Maher, president; Thomas W. Olcott, secretary and treasurer, and V. A. Krepps, superintendent.

STEUBENVILLE, OHIO.—Wheeling capitalists are arranging to build an electric street railway to Mingo Junction. They have already purchased ground on the outskirts of the city on which a power house will be erected, and have taken an option on the street railway and electric light plant of the home company.

WEYMOUTH, MASS.—The Braintree & Weymouth street railway has been sold to the Philadelphia Transit Company, Philadelphia, Pa. This company recently purchased the Rockland & Abington and the Hingham street railways. The Braintree & Weymouth road is 18 miles long, extending from Braintree to East and South Weymouth.

PARIS, TENN.—A charter has been granted to the Paris Electric Street Railway Company, which is capitalized at $100,000. The incorporators are John G. Sweeney, W. W. Farabough, W. A. Carter, H. B. Swinney, John R. Rison, Y. Q. Caldwell, J. M. Porter, J. C. Porter, C. P. Henderson, O. C. Barton, W. C. Johnson and F. M. Vancleave.

POTTSTOWN, PA.—The Pottstown Passenger Railway Company has decided to extend its line from Sanatoga to Limerick Square, and effect a junction at the latter place with the Trappe & Limerick Square Electric Railway. The latter named company is a new organization. The distance between Sanatoga and Limerick Square is four miles.

CHICAGO, ILL.—Judge Grosscup, of the U. S. Circuit Court, has approved the petition of John McNulta, receiver of the Calumet Electric Street Railway Company for leave to improve the terminal facilities of the road. The receiver will expend $45,000 in installing electrical apparatus in the terminal station at Stony Island Avenue and Sixty-third Street.

NEW YORK, N. Y.—Mr. P. H. Flynn and associates of Brooklyn Borough are soon to ask for bids for the construction of an electric railway across Jamaica up to Rockaway Beach. The road will be built on a trestle structure, which will be filled in and macadamized so that it can be used for bicycles and carriages, turnouts being provided at convenient points. It is thought that the road will start in Brooklyn, somewhere along Liberty Avenue.

NEW BRITAIN, CONN.—The Bloomfield, Tariffville & East Granby Tramway Company has completed its organization. The capital of the company is $100,000, and the officers are, president, M. A. Crilley; vice-president, Hiram R. Mills; secretary, George D. Curtis; treasurer, Edward W. Rowley. The charter authorizes the company to construct an electric railway from the Hartford town line to Bloomfield and Tariffville and thence to East Granby.

NEW YORK, N. Y.—The Municipal Street Railway Company of this city was recently incorporated at Albany, to construct a road on the west side of the city from 116th Street and Sixth Avenue to the northerly line of New York City, with branches to connect with the main line. One of the directors states that the new company is entirely independent of all railway interests in the city, and that it does not seek alliance with any of them. A three-cent fare will be charged.

GREENSBURG, PA.—Surveyors are at work on the final survey of the proposed electric railway between Manor and Pittsburg. The section of the road between Greensburg and Manor has been in operation for a couple of years. It is proposed to connect with the United Traction Company, of Pittsburg. The Greensburg, Jeannette & Pittsburg Electric Railway Company is conducting the enterprise. A road has also been contemplated from Harrison City to Dixmont, a distance of six miles.

LEXINGTON, KY.—An electric railway is contemplated between Lexington and Frankfort. The proposed line will run from Lexington almost due west through a thickly populated farming district to Versailles, which has a population of about 5,000 inhabitants. From Versailles the road will run to the Kentucky River about six miles further west, the point where the line touches the river being about 18 miles from Lexington. The river bank will then be followed for a distance of 10 miles, to Frankfort. The route along the river is through a gorge and will be one of the finest scenic roads in the country. Mr. R. T. Gunn, superintendent of the Lexington Railway Company, is interested in this enterprise.

LEGAL NOTES.

THE HATCH STORAGE BATTERY CO., of Boston, was temporarily enjoined by Judge Colt in the U. S. Circuit Court last week in the suit instigated by the Electric Storage Battery Co., of Philadelphia. The decision was an oral one, Judge Colt not considering that there was sufficient evidence to make necessary a written opinion, having on previous occasions given decisions on the storage battery problem, and refusing to admit that there was any difference whether the active material was supported by the lead conductor, or by the porous partition, as in the case of the Hatch battery, so far as the patent question was concerned. The Hatch Storage Battery Co. has appealed the case, and appears confident that it will get a reversal of the decision. Counsel for the Electric Storage Battery Co., John R. Bennett, New York, and for the Hatch Storage Battery Co., Causten Browne, Boston.

ADVERSE TO THE THREE-WIRE PATENT.—The motion for preliminary injunction in the suit of Edison Electric Light Company against the Imperial Electric Light, Heat & Power Company, of St. Louis, has been decided by the court against the Edison Company. The opinion of the court, through Judge Adams, which is very brief, is as follows: "After a careful consideration of the proof before me I have reached the following conclusions, which I will state in a summary way: First—There has been no adjudication by any court of concurrent jurisdiction of the validity of complainants' patent, after a hearing on the merits. Second—There has been no such public and general acquiescence in complainants' right to an exclusive monopoly in the three-wire system of electrical distribution as to raise a fair or reasonable presumption of the validity of the patent. In fact, the proof shows quite the contrary. Divers parties appear to be employing the three-wire system in direct and intentional disregard of complainants' claim to a monopoly therein. Such being the facts, it is clear that no case is presented for a preliminary injunction. The parties' rights must be determined after proof taken, and a hearing on the merits. Richard N. Dyer and A. C. Fowler appeared for complainants; Charles A. Brown and George H. Knight for defendants. This, it is alleged, practically opens the three-wire invention to public use, as, the patent not having come to a hearing upon its merits until so late in the life of the patent, it will now be impossible to secure a decision of the court in a contested case prior to the expiration of this patent.

PERSONAL NOTES.

PROF. ELIHU THOMSON is the subject of an appreciative note, with portrait in a recent issue of "Success."

MR. R. J. RANDOLPH, JR., formerly of the Excelsior Electric Company, has become connected with the Bryan-Marsh Company, of New York.

MR. E. W. STEVENSON has been busily engaged for some weeks past on the electrical engineering work at the exhibition in Madison Square Garden.

MR. KEMPSTER B. MILLER has resigned from the staff of the International Correspondence Schools, Scranton, Pa., to accept a position with the Kellogg Switchboard & Supply Company, Chicago, Ill.

MR. FRANK W. HARRINGTON, so well known in the insulated wire trade, has joined the Roebling forces and is pushing things in their insulated department. He has many and hearty good wishes on his new departure.

MESSRS. CORRIGAN AND OSBURN, of the American Electric Vehicle Company, Chicago, were both in New York this week; the former made a hurried trip and returned almost immediately, while the latter will remain during the Electrical Exhibition. Mr. Corrigan is expected back in New York during the last of the month.

MR. G. H. PROCTOR, vice-president of the Anchor Electric Company, Boston, Mass., sailed from Boston on May 3 for an extended tour in England, Scotland and Ireland and the continent. He will visit the principal cities, introducing Anchor specialties, and will take pleasure trips in England and in Switzerland as a summer outing.

MR. JOHN W. LIEB, JR., who was so successful in his work for the old Edison Electric Ill. Co. of New York, has now been appointed associate general manager to its big successor, the New York Gas and Electric Light, Heat and Power Co., with heavier duties and larger responsibilities, to all of which, as usual, he will rise superior.

MR. E. R. WEEKS, of Kansas City, Mo., is not less prominent there in philanthropic work than in the field of electric light and power. He is president of the Humane Society of Kansas City, under whose auspices has just been held one of the most successful meetings ever devoted in this country to the cause of humane education. By actual count there were present 10,000 adults and 25,000 children.

MR. TIMOTHY HOWARD, telegraph engineer of the Australian post and telegraph department, at Melbourne, Australia, has been paying New York a few days' visit. Mr. Howard is making a tour of inspection of the telegraph and telephone systems and other electrical developments in the principal countries of the world. He started from Melbourne last January, coming direct to San Francisco. He is travelling eastward and expects to get back home about Christmas time. He has visited the principal cities in the United States and Canada, and will stop at the principal centres in England and Europe. Mr. Howard sailed for England Wednesday of this week. He made many friends during his short stay in this city.

Trade and Industrial Notes.

THE NATIONAL ELECTRIC COMPANY, with an authorized capital stock of $25,000,000, was incorporated in Trenton, N. J., on May 1.

THE ROLFE ELECTRIC COMPANY has been incorporated at Chicago, with a capital stock of $50,000, by Charles A. Rolfe, Henry H. Belfield and A. Miller Belfield.

THE ROYAL ELECTRIC COMPANY, Peoria, Ill., is sending out to the trade a series of leaflets, giving points on its transformers and alternators. The information is pithy and of a suitable nature for busy men.

CATALOGUES WANTED.—The electric light plant of the Globe Furniture Company, Northville, Mich., was destroyed by fire on April 30. The company desires to obtain copies of catalogues of electric light supplies and equipment.

THE INDEPENDENT TELEPHONE MANUFACTURING COMPANY is the name of a new concern organized in Jersey City, N. J., with a capital stock of $100,000. The incorporators are Charles N. King, W. B. Brister and Seward Davis.

THE PNEUMATIC SUPPLY & EQUIPMENT COMPANY has been organized under the laws of the state of New York and has opened an office at 120 Liberty Street, New York. This company will deal generally in compressed air equipment.

THE WESTERN ELECTRIC COMPANY, of Chicago, has the Western agency for the Tuerk alternating current ceiling fans. These fans are made for 60, 125 and 140 cycles, and for 52 and 104 volts. A complete stock of these fans is carried in Chicago.

THE ROYAL ELECTRIC COMPANY, Peoria, Ill., announces that Mr. J. E. Duval, of Charlotte, N. C., will attend to the sales of the company's alternating current generators and transformers in the states of North Carolina, South Carolina and Georgia.

THE PHOENIX ELECTRIC TELEPHONE COMPANY, formerly at 93 Washington Street, New York, has moved its entire plant to larger quarters at 443-445 Greenwich Street. This change was made to meet the need for increased manufacturing facilities.

THE PENNSYLVANIA TUBE WORKS COMPANY, Pittsburg, has let contracts aggregating $40,000, for the installation of a complete electric power

plant at this establishment. Electric power will be used to run the trains, cranes and other heavy machinery.

THE KENTUCKY ELECTRIC COMPANY of Frankfort, Ky., has been organized at Owensboro, with a capital stock of $22,500, by the following named incorporators: A. H. Kreitter, Joseph H. Parrish, E. T. Franks, A. J. Williams and W. S. Wilson.

THE ELECTRIC ARC LIGHT COMPANY has moved to the Bowling Green Building, 11 Broadway, New York. The company has largely increased its manufacturing facilities and is in a position to promptly ship direct and alternating current enclosed arc lamps.

THE PROTECTED RAIL BOND COMPANY, of Philadelphia, has been chartered at Harrisburg, with a capital stock of $25,000, to deal in electrical appliances. The incorporators are Charles J. Myer, A. H. Englund, Edwin B. Ross, F. R. Shattuck and Edward Everitt.

THE AERO-BLAST & POWER COMPANY is the title taken on by the Independent Telephone Company in Chicago, for the purpose of enabling it to manufacture electrical devices and appliances. The capital of the company has been decreased from $1,000,000 to $100,000.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., has issued a circular on the subject of Dixon's No. 635 graphite for lubricating gas-engine cylinders, valves, pistons and cylinders of air-brakes, pumps, etc. This graphite is not affected by any degree of heat.

MESSRS. MOREHOUSE & MORRILL, mechanical and electrical engineers, Quezaltenango, Mexico, have leased for a term of years the electric lighting company of Quezaltenango, the Western Telephone Company and the Coast Telephone Company. The firm is composed of Messrs. H. H. Morehouse and G. A. Morrill.

THE EAST RIVER ELECTRIC COMPANY is the title of a new concern organized at Bluefield, W. Va., for the purpose of manufacturing electrical machinery. The capital stock is $50,000. The incorporators are W. A. Cather, Edwin Mawn, W. P. Hawly, G. A. Shirley, R. E. Johnson, all of Bluefield.

THE BANKERS' ELECTRIC PROTECTIVE COMPANY, of New England, has been incorporated in New Jersey, with a capital stock of $300,000. The incorporators are: Robert S. Green, Elizabeth; Theodore S. Beecher, Irvington; Charles J. Dodd, James P. Dodd and John P. Toumey, all of Brooklyn, N. Y.

THE COLUMBIA ELECTRIC VEHICLE COMPANY has been incorporated, with a capital stock of $5,000,000, by Charles A. Wendell, Andrew H. Scobel, Anthony N. Jeshera, Sherman M. Granger, Francis R. Foraker, Walter T. Dryfoos and Roland B. Harvey, all of New York, and W. B. Greely, of New Rochelle.

THE UNIVERSAL CONDUIT, LIGHT, HEAT & POWER COMPANY of Wilmington, Del., has been incorporated to manufacture and sell conduits of every description. The capital stock of the company is $150,000, and the incorporators are Edmund Mitchell, Jr., Joseph N. Harman and Samuel White, all of Wilmington.

THE AMERICAN ELECTRICAL HEATER COMPANY, Detroit, Mich., has recently established an office in Mexico City for the sale of its electrical appliances in Mexico. This company reports that it is making heavy shipments to England, Germany, South Africa and South America, while its trade in this country is the largest in the history of the company.

THE H. T. PAISTE COMPANY'S new attachment plug is becoming popular with the trade. It is possessed with many features of merit. The Electric Appliance Company, of Chicago, is general western agent for these goods. It carries a large stock in Chicago and tells of a growing demand for these plugs that cannot but be gratifying to the manufacturers.

PIPE WORKS BURNED.—The works of the Michigan Pipe Company, at Bay City, Mich., were destroyed by fire on May 5. The fire started in the creosoting department. The company's loss amounts to about $30,000, with insurance of $16,150. This is the second time the works have been destroyed during the 25 years of their existence. The factory will be rebuilt at once.

GARTON MOTOR LIGHTNING ARRESTERS.—The demand for a lightning arrester and kicking coil for protection of fan motors and other small power motors, at a low price, has encouraged the Garton-Daniels Electric Company, of Keokuk, Iowa, to place on the market a full line of these devices. The company will be glad to furnish full information and prices upon application.

MR. GEORGE H. DANIELS, general passenger agent of the New York Central Railway, has issued a neat brochure, entitled "A Message from Garcia." The author of the story is Elbert M. Hubbard, and an important lesson on the performance of duty is taught. There is a great demand for this little work, the first edition of 100,000 being soon exhausted. A second edition of 100,000 has been ordered.

THE TAUNTON LOCOMOTIVE MANUFACTURING COMPANY.—Hereafter the Wainwright department of this company will be represented in New York City by Mr. Charles H. Payne, with offices in the Singer Building, corner Broadway and Liberty Street. The company's catalogue, containing illustrations, schedules and descriptions of its feed water heaters, surface condensers and expansion joints, is now ready for distribution.

MR. C. A. GATES, manager of the Automatic Engine Department of Russell & Co., Massillon, Ohio, says there has been an extraordinary demand for that company's high speed automatic engines for electric lighting and power. Among recent orders have been contracts for complete steam equipment of large lighting plants in New Orleans, La., and Vicksburg, Miss., and a contract with the Cleveland & Eastern Railway for 2100-hp in boilers and engines.

NEW DYNAMOS INSTALLED.—The owners of the Robert Law Building, 132 Water Street, Chicago, have installed two 100-kw Western Electric direct-current dynamos, for the purpose of furnishing their tenants power and light. The work of installation was done by the Construction Department of the Western Electric Company. The Wolff Manufacturing Company, manufacturers of plumbing supplies, Chicago, has recently installed a 100-kw Western Electric dynamo for light and power.

THE CENTRAL TELEPHONE COMPANY, of Kalamazoo, Mich., is installing several of the Mason Telephone Pay Station Company's desk set pay stations for use in booths. The Gordon Telephone Company is an extensive user of the Mason Company's nickel No. 4 machine, for which the Mason Company reports having received several duplicate orders recently. The Mason pay stations are meeting with good sales in Canada, a recent shipment having been made to Edmonson, Alberta, Canada.

THE MONTAUK MULTIPHASE CABLE COMPANY, 100 Broadway, New York, has arranged for an exhibit of its automatic thermostatic fire detective cables at the Paris exposition next year. The company will make a very complete exhibit of its fire detective wires in connection with all interior electrical adaptations. The company will have a complete display of its product in connection with all interior wiring, at the convention of the Municipal Electricians at Wilmington, Del., next September.

CORSICANA, TEX.—The energetic and pushing Corsicana Gas & Electric Company has sent to its friends a copy of the Dallas and Houston "Illustrated Industrial World," which contains a very good description and review of work in that prosperous city. Mr. J. E. Whiteselle is the president of the company, and Mr. J. D. Gibbs, secretary and manager. The company has a water gas system capable of 40,000 cubic feet a day, and five miles of gas mains. Its electric lighting plant for arc and incandescent work has a capacity of about 300 hp., with Edison, Warren and Fort Wayne apparatus.

THE C & C ELECTRIC COMPANY, 143 Liberty Street, New York, has decided to open its own office in Chicago, Mr. Martin J. Insull, its former sales agent for the Chicago territory, having severed his connection with the company and located in New York as Vice-President of the General Incandescent Arc Lamp Company. Mr. E. Sanderson, who has been representing the C & C Company in St. Louis for a year past, was appointed the manager for the Chicago territory on May 1. A suitable office location has not yet been secured, but it is quite probable that quarters will be found in the Monadnock Block.

THE SCHMIDT & BRUCKNER ELECTRIC COMPANY, New York, has moved into its new factory at 135 Elm Street, corner of Howard, where it will have more than double the space of its former quarters, and other improved facilities for handling its business. The company reports that during the last year the demand for its apparatus increased far beyond the capacity of its old factory and on this account it was several weeks behind in filling its orders. The company is now in a position to handle a much larger trade than it has been heretofore able to undertake, and it will also be able to fill its orders with greater promptness. The company regards the necessity of having to seek larger quarters as an evident appreciation in the telephone trade of its apparatus.

STREET RAILWAY BRIDGES.—The contracts for the bridges on the line of the Shelton Street Railway Company have been let to the Berlin Iron Bridge Company, of East Berlin, Conn. These bridges consist of what is known as "Peck's Mill" bridge, which is a deck construction, having four 130 ft. riveted lattice spans, and three plate girder spans about 40 ft. each. The total length of the bridge is 654 ft. The trestle for the South End Land Company consists of one 130 ft. riveted lattice span, one 30 ft. and one 60 ft. plate girder span, making a total length of 220 ft. Besides these are two plate girder spans, one of 60 ft. over Far Mill River, and a bridge in the town of Shelton, which answers as a highway bridge, as well as a crossing which carries the street railway tracks.

STEAM-BOILER PRACTICE.—Mr. Walter B. Snow, of the B. F. Sturtevant Company, Jamaica Plain Station, Boston, is the author of a book just published, entitled "Steam-Boiler Practice in Its Relation to Fuels and Their Combustion, and the Economical Results Obtained with Various Methods and Devices." The work is simple in its treatment and reasonably comprehensive in its character and deals primarily with effects rather than causes, and undertakes to indicate the possible gain or loss to result from a given arrangement, pointing out the way toward securing the highest efficiency in steam-boiler practice. It is neither too abstruse for the practical engineer nor too rudimentary for the technical student. Special attention has been given to the matter of draft and its influence upon the economical results, both quantitatively and commercially.

THE TRIUMPH ELECTRIC CO., Cincinnati, Ohio, reports that it is compelled to work at night to filling orders now on hand. It states that business so far this year is almost double that of any previous year, and that the outlook is very bright. It has at present on its books orders for eighty-five machines, among them being one 75-kw direct-connected and one 50-kw direct-connected for the Electrical Terminal Building, Cleveland, Ohio; one 75-kw direct-connected for the Kentucky House of Reforrm, Lexington, Ky.; one 80-kw belted generator and two 60-hp belted motors for the A. I. Root Co., of Medina, Ohio; one 75-kw direct-connected for Wm. H. Elsinger & Co., St. Paul, Minn.; one 50-kw belted generator for the Medina Electric Light & Power Co., Medina, Ohio; two 30-kw direct-connected generators for the Torchlight Duncker & Renard Carpet Co., St. Louis, Mo.; one 50-kw belted generator for the Kentucky State Penitentiary, Frankfort, Ky.

THE SPRAGUE ELECTRIC COMPANY has just issued another of its series of artistic catalogues. The latest production is devoted to some very excellent illustrations and clear descriptions of Lundell fan motors. The construction of these motors and the method of manufacture of the various parts are clearly illustrated. The text contains some very interesting reading matter in connection with the use of fan motors. The first picture under the front cover represents what is said to be the real North Pole. It consists of a Lundell fan motor amid arctic surroundings and covered with icicles, with the fan in vigorous operation. The operating current is evidently obtained from the atmosphere, since the picture indicates that there is violent electrical disturbance in the neighborhood, which is manifested by a great display of the aurora borealis. The catalogue contains illustrations of the various styles of fan motors manufactured by the Sprague Company, and it is gotten up in such an attractive manner that no doubt many will find much interest in reading its pages.

MR. A. W. KOENIG has been appointed to represent the Belknap Motor Company, Portland, Me., in the Middle Atlantic and Southern States, for the sale of the Chapman voltage regulator, graphite and woven-wire copper and carbon brushes, brush holders, direct-current standard motors and dynamos, and all the products of the Belknap Company, together with the marine multi-polar-type motor with controller, which has been placed on a number of government vessels. This latter machine is especially adapted for hoisting anchors, boats, etc. Mr. Koenig's headquarters are at 9 Maiden Lane, New York, and any communications sent to him will receive as prompt and careful attention as though they were sent direct to the factory at Portland.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 2, 1899.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

623,989. ELECTRIC MOTOR; Homer W. Corse, Melrose, Mass. App. filed Sept. 9, 1898. (See Current News and Notes.)

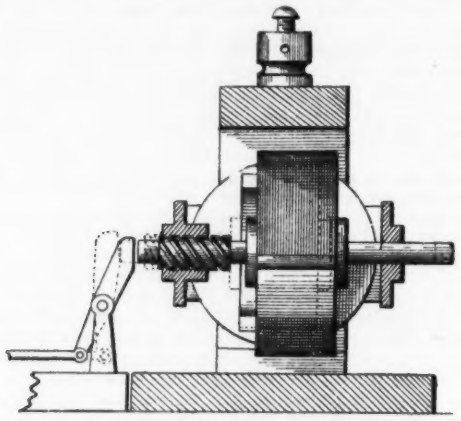
624,075. TELEPHONE SWITCHBOARD; J. M. Overshiner, Elwood, Ind. App. filed Dec. 17, 1897. The invention consists of certain details of construction intended to effect the restoration of the annunciator drop to the latch devices by the insertion of the plug into the jack and also by the withdrawal of the plug from the jack.

624,095. TELEPHONE REGISTER; H. T. Richards, New York, N. Y. App. filed Jan. 19, 1899. The invention comprises a device in co-operative relation to the subscribers' instrument, which permits the free removal of the telephone from its support for the purpose of establishing or receiving a call, but which cannot be returned to its support without special control of the obstructing device, thereby insuring the attention of the subscriber to the register. Means are provided for preventing the operation of the register when the subscriber is unable to obtain communication with the called subscriber.

624,124. ELECTRIC LINE CONDUCTOR; D. G. Stoughton, Hartford, Conn. App filed June 17, 1897. A railway conductor enclosed in a conduit covered by two flexible flaps arranged at an angle with each other to shed water. The plough passes between the flaps, temporarily separating them.

624,125. ELECTRIC LINE CONDUCTOR; D. G. Stoughton, Hartford, Conn. App. filed July 20, 1897. An improvement upon the preceding patent, consisting in providing an electric heater inside of the conduit to prevent freezing, the heated air being retained by the flexible cover flaps.

624,128. PERMANENTLY ADJUSTED TELEPHONE; E. H. Thielscher, Brookline, Mass. App. filed Sept. 1, 1898. (See Current News and Notes.)



No. 624,299.—Electromagnetic Actuating Device.

624,141. ELECTRIC METER; Roger S. White, New York, N. Y. App. filed Sept. 2, 1898. (See Current News and Notes.)

624,142. MEANS FOR REDUCING FRICTION IN ROTATING SHAFTS OF ELECTRIC METERS; Roger S. White, New York, N. Y. App. filed Oct. 5, 1898. (See Current News and Notes.)

624,167. COMMUTATOR BAR; C. F. Brooker, Ansonia, Conn. App. filed June 2, 1897. (See Current News and Notes.)

624,218. ELECTRIC CIGAR LIGHTER; W. J. Kessler, Auburn, Ind. App. filed Sept. 9, 1898. Consists of a vertical two-part shell having diametric openings adjacent to the flame through which the cigar is inserted, a spring-pressed and vertically movable wick tube mounted in the shell by a swivel connection, and means for so suspending the lighter as to relieve the flexible conductor of the weight of the lighter.

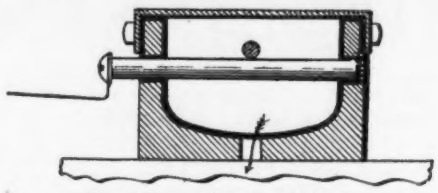
624,230. SECONDARY BATTERY PLATE AND METHOD OF PRODUCING SAME; A. J. Marquand, Cardiff, England. App. filed Dec. 27, 1897. (See Current News and Notes.)

624,250. CONTROLLER FOR ELECTRICALLY PROPELLED VEHICLE; E. D. W. Reichel, Berlin, Germany. App. filed Feb. 2, 1899. The invention is best described in one of the claims as follows: The combination with a plurality of electric motors mounted upon and propelling different cars of a train, of a conductor extending between and adapted to unite the said motors, and controllers also provided upon the different cars and associated each to each with the said motors comprising resistance-governing contact parts, switching mechanism for connecting the motors in series and parallel arrangement, and co-operative switching devices for securing the connection of the corresponding motor and the regulation of its operative condition either by an additional or corresponding controller, substantially as described.

624,272. AUTOMATIC CIRCUIT CLOSER; J. A. Wall, Providence, R. I. App. filed March 11, 1898. A thermostatic circuit closer arranged with its fusible portion isolated from the other parts of the device which tend to absorb or withdraw heat therefrom.

624,277. ELECTRO-PNEUMATIC CONTROLLING SYSTEM; Geo. Westinghouse, Pittsburg, Pa. App. filed Aug. 20, 1898. (See Current News and Notes.)

624,299. ELECTROMAGNETIC ACTUATING DEVICE; C. E. Choller, St. Louis, Mo. App. filed Oct. 28, 1898. The armature shaft of a small motor is provided with threads which work in a threaded bearing; the armature



No. 624,304.—Electric Railway.

is normally located slightly out of the magnetic field so that when the motor is energized, the armature will be moved in the direction of its shaft, such motion being utilized to move a lever or other actuating device.

624,300. TESTING APPARATUS FOR ELECTRIC SIGNALING CIRCUITS; A. Coleman, Thornton, Mass. App. filed May 16, 1898. Means whereby readings of an ammeter and a voltmeter may be taken at the same time without temporarily putting the circuit out of use. Consists of a normally open branch circuit containing the ammeter and a normally open shunt circuit containing a voltmeter and a switch arranged to include the branch circuit in series with the signaling circuit, and for simultaneously closing the shunt circuit.

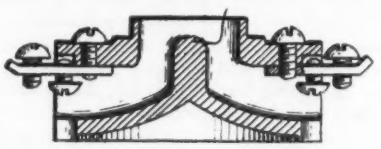
624,304. ELECTRIC RAILWAY; H. B. Cox, New York, N. Y. App. filed Oct. 31, 1898. The conductor is freely supported in a closed conduit, the top only of which is of conducting material, a magnet carried by the car lifts the conductor into contact with the top of the conduit from which a brush takes the current; the conductor rests loosely on cross pins set in the conduit, to which the feeders are connected.

624,382. ELECTRIC PIANO; G. Schaede and H. W. Shonnard, New York, N. Y. App. filed Aug. 17, 1895. A single lever operates the motor starting switch and a belt shifter simultaneously, the invention concerning the details.

624,386. ELECTRICAL ROSETTE; A. P. Seymour, Syracuse, N. Y. App. filed Feb. 10, 1899. The essential feature of the invention is a rosette formed in one piece with two distinct passages leading from the center of the outer face and extending inwardly and outwardly, one to each side; the two wires leading through these passages are thus entirely separated and there is little liability of short circuiting.

624,390. ELECTRIC SIGNALING SYSTEM; E. S. Simms, Denver, Col. App. filed Oct. 28 ,1898. Intended for mine shafts. A normally open circuit extends through the shaft and is provided with circuit closers as each station, the invention relating particularly to the construction of the circuit closer, whereby it is automatically opened after being closed for signalling.

624,396. CONTROLLER FOR ELECTRIC TRAIN SIGNALING APPARATUS; W. A. Stambaugh, Effingham, Ill. App. filed March 1, 1899. The device is intended to control bell signals located at railway crossings, the



No. 624,386.—Electrical Rosette.

invention consisting in a peculiar combination of levers and contacts with two pairs of electromagnets.

624,409. CONTROLLER FOR ELECTRIC ELEVATORS; B. C. Van Emon, San Francisco, Cal. App. filed Aug. 30, 1898. A mechanical controlling device arranged to be operated from any point in the elevator shaft and controlling the electrical controller, the invention consisting particularly of a rocking shaft carrying a series of arms which engage with contacts, and by reason of mounting the said contacts to yield, they are brought gradually into action on the continued motion of the rocking shaft.

624,428. ENGINE STOP; J. Brady, New York, N. Y. App. filed June 18, 1898. The engine stop is a mechanical device for shutting off the steam; it is operated by a spring motor, or a weight which is tripped into action by a lever actuated by an electromagnet.